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TRANSACTIONS

OF THE

NATURAL HISTORY SOCIETY,

OF

NORTHUMBERLAND, DURHAM,

AND

NEWCASTLE UPON TYNE.

VOL. I.

NEWCASTLE:
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PREFACE.

The Committee of the Natural History Society of Newcastle conceive, that it might be necessary to prefix, to the first Volume of its Transactions, a short account of the origin and progress of the Institution, and some cursory remarks on the objects which it embraces.

It will naturally occur to many, into whose hands this volume may come, to enquire, why, when the Literary and Philosophical Society had subsisted during so many years, with a view to the promotion of General Science, there should be any reason for the formation of distinct establishments.

This, however, has been found to be the case elsewhere; that as the boundaries of Natural Science have been gradually extended, separate institutions have arisen for the more convenient investigation of particular branches. Thus, out of the Royal Society of London, have gradually arisen, the Antiquarian, Linnæan, Geological, Astronomical, Horticultural, and Zoological Societies.

It was, no doubt, the original intention of the founders of the Literary Society of Newcastle to embrace all the objects of scientific research; but it was soon found, that, for want of sufficient funds and accommodations, many departments were necessarily neglected, and that it was extremely desirable that new institutions should be formed, not as rivals, but as subsidiaries to that, which the members of each separate establishment always wished to have considered as the Parent Institution.

With these views the Natural History Society was established, and the volume which it now submits to the public attention may be considered as its first fruits. The Committee presume to hope that it will be found to contain many valuable offerings to the enlargement of natural knowledge in its three great departments; but especially, that the papers, which it contains on the Geological peculiarities of the district, with which it is more immediately connected, will be found particularly valuable.

The Committee deem it necessary to state, that the authors of the several papers are respectively answerable for the facts and inferences contained in each.

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TRANSACTIONS

OF

THE NATURAL HISTORY SOCIETY,

&c. &c. &c.

No. I.—*Notice of a new Species of* Swan. *By* Mr. R. R. Wingate.

Read October 20, 1829.

A Swan was shot on the 7th February, 1829, near Haydon Bridge, in the County of Northumberland, which came into possession of the Literary and Philosophical Society of this town, and was sent to me to be preserved for the Museum, by which I was enabled to point out, from personal observation, to a certain extent, the specific distinction between it and the common Wild Swan, which consists chiefly in the great difference of weight and size. The Wild Swan (*Anas Cygnus ferus* Lin.), exceeds the other in length 11 inches; in breadth 10½ inches; and in weight 5¼ lbs. There is also a difference in the length, marking, and formation of the bill; the upper mandible at the base rising into a knob, marked with a triangular dusky spot, which, in the Wild Swan at the same part, is hollow, and of a bright yellow; and the nostrils are pervious, but in the new species they are opaque. The upper part of the neck is also much smaller, and the lower part thicker, which gives it an elegant appearance. The tail consists of only twenty feathers, whilst in the Wild Swan there are twenty-two. All the plumage, in both

species, is white, except the fore part of the head of the new one, which is spotted with rust colour. The legs are black, and placed further behind, and the margin of the inner toes is scalloped.

It differs, moreover, considerably in its internal anatomical structure. The tube of the trachea, or *aspera arteria* in its egress, is about two-thirds less in circumference, and, a little preceding the bone of divarication, is swollen; but in the *Cygnus ferus* at the same part, is much compressed, and the bronchial tubes $2\frac{3}{4}$ inches longer than in the former, which is a very great mark of specific distinction. The formation of the sternum is also different, and the membraneous portion thereof likewise. Their ribs also vary in number, the new species having only nine on each side, and the other ten. This difference cannot arise from age, sex, or season; as both species seem nearly mature, both females, and shot about the same time of the year. Therefore, I think (but with due submission to abler ornithologists), it may be safely added, as a perfectly distinct species of *Anas*, to the British Fauna.

No. II.—*Some Notice of the Falco Apivorus, or Honey Buzzard, shot in Thrunton Woods, in the Parish of Whittingham, in the County of Northumberland, August* 31, 1829. *By the Hon.* H. T. Liddell, M. P.

Read November 17, 1829.

This Bird is so extremely rare in the British Isles, that I consider a particular account may be acceptable to the Society. Our learned and accomplished ornithologist, Mr. Selby, to whose inspection the specimen in question has been submitted, states, in his *Illustrations*, that "the instances of this bird being killed in England are but few. Latham says, that during such a number of years as he has been a collector, he has received but one fresh specimen. I have never met with it in a living state, nor been able to obtain it newly killed."

White, in his *Natural History of Selborne*, mentions that a pair of Honey Buzzards built their nests on a tall beech tree in that neighbourhood, in the summer of 1780, and Montagu describes one which was killed in Lord Carnarvon's park, at Highclere, in Berkshire. That distinguished naturalist, in his *Supplement to the Ornithological Dictionary*, says, that "later observations have served to confirm his former opinion of the very great scarcity of this species in England."

These three are the only instances which I find recorded of the Honey Buzzard having been met with alive in this country, as Bewick gives no account of the specimen from which his drawing was taken, which, unlike the usual productions of our unrivalled engraver, by no means accurately represents the peculiar form and attributes of this curious

* A specimen of the Honey Buzzard was shot a few years since on the Moors near Wallington, Northumberland, and which is now preserved in the Ashmolean Museum, at Oxford, having been presented to it by W. C. Trevelyan, Esq. of Wallington.

species. His description is still more defective in omitting to notice particularly the distinguishing traits which have induced Cuvier to separate the Honey Buzzard from the genus *Falco*, or *Buteo*, and to include it, with some other foreign species possessing the same character, in his genus, or division, *Pernis*. An attentive observer of these characteristics will perceive, that, in many respects, the Honey Buzzard seems to form a link between the rapacious and the insectivorous tribes. The weakness of the bill and claws, the gape of the mouth, the flat head, and large full eye set round with small and very close feathers, the absence of the projecting eyebrow, and of the notch in the upper mandible of the bill, conspicuous in the whole tribe of *Falconidæ*, with the pointed wings and long spreading tail, are all analogous conformations with the tribes of the Cuckoo and Goatsucker. The specimen, which I am now describing, differs from all the accounts I have met with, in having all the under parts of a dark chocolate brown, with only a few white bars under the wings. In other respects it nearly coincides with the description in Mr. Selby's work. The tail is very beautiful, long, and spreading, with three distinct bars of dark brown, and the under side of the quill feathers of the wings is also prettily streaked and shaded with bars of dove-colour upon a light ground, terminated with a broad bar of dark brown at the extremity of each feather. There is another bar of the same colour narrower and less regular at the upper extremity, and this arrangement of colour is finely set off by the deep chocolate brown of the under coverts of the wings. The legs are remarkably thick, and had somewhat of an œdematous, or gouty appearance, which has gone off as the skin has dried. It is decidedly an adult specimen, and being in a state of moult has both old and young feathers. When killed it was pursuing a wood pigeon, which, rushing by, attracted the attention of the game-keeper. The bird was excessively fat, so much so, that its grease ran from the holes pierced by the shot, and rendered it a difficult task to preserve the skin clean for stuffing, as it flowed down the blade of the knife and over the hands of the operator. It was full of the larvæ of wasps, and I observed in the vicinity one or two wasp nests pendent on thorns, which might

have attracted this rare visitant, for it is difficult to suppose it capable of obtaining such food from the combs formed in the ground.

This specimen is placed in the Museum at Ravensworth Castle, which I beg to take the present opportunity of offering at all times to the inspection of any members of the Society.

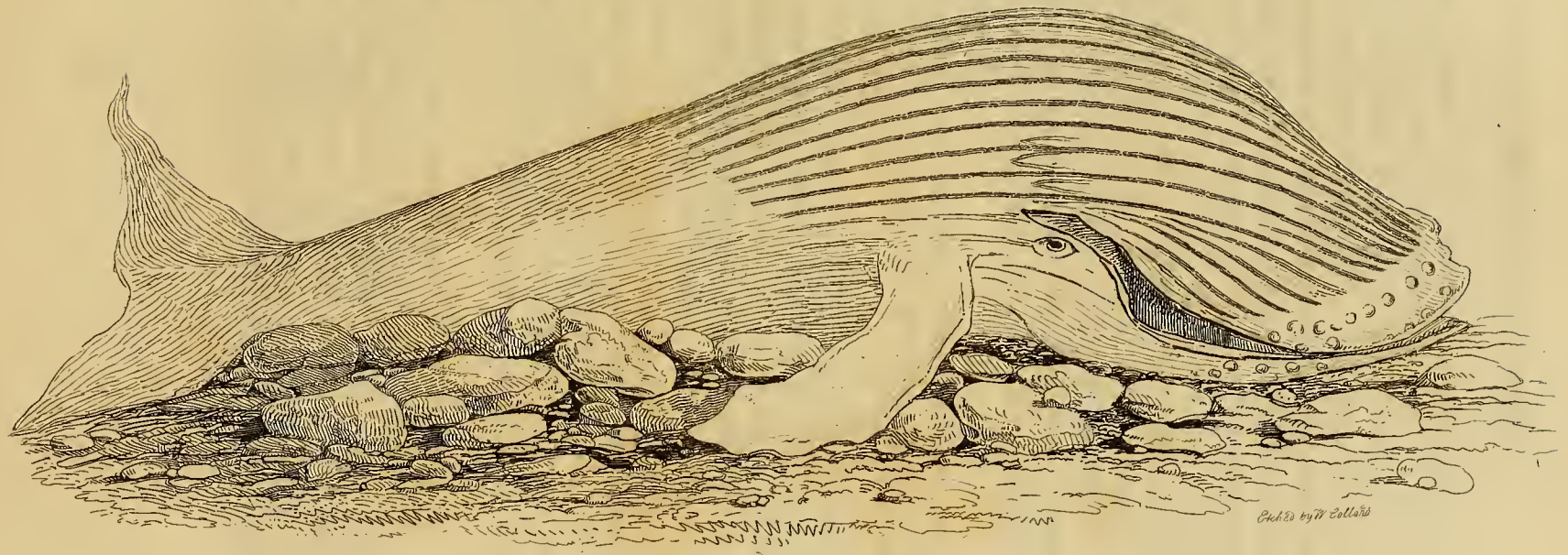
No. III.—*Some Account of a Whale stranded near Berwick-upon-Tweed. By* George Johnston, M. D., *Fellow of the Royal College of Surgeons, Edinburgh.*

Read December 15, 1829.

On the morning of Saturday, the 19th September, 1829, a Whale was thrown on shore about two miles north of Berwick. When viewed from the bank under which it lay, the resemblance to a boat, with the keel upwards, was so exact and striking that the comparison was made by every one of its numerous visitors; and Wilkie, the celebrated painter, who was one of them, is said to have remarked that a boat-builder might read to himself a good lesson from this mighty monster of the deep.

It lay on its back with the belly upwards, was of an oval shape, swollen and thickest near the head, whence it tapered gradually to the tail. The extreme length was between 35 and 36 feet; the greatest circumference 24 feet. The back, so far as could be seen, was black, smooth, and somewhat glossy; and I was informed by the person who superintended the removal of the blubber, and whose attention was directed to the point, that there was no dorsal fin, but in lieu of it an obscure protuberance. The blow-holes were separate, about 6 feet from the snout, and each was furnished with a valve, which, in texture and shape, was compared to a moistened bladder. The head was obtusely pointed; the upper jaw considerably smaller and more acute than the under, which was warted with round knobs of the size of an egg, and near the end of it there was a large oblong swelling, which might be a chin, and from which two small grooves run forward. The gape was 10 feet in length, and placed, with some regularity, along its margins were a considerable number of knobs or tumours, similar to those above mentioned. The mouth was filled with the whalebone, arranged in a beautifully pectinate

PLATE I.



manner. The eyes, situated above the angle of the gape, protruded slightly, and though small, when compared to the bulk of the body, were still greatly larger than those of an ox or horse, to which they have been compared. The belly was furrowed with great regularity; the furrows, deep and broad, commenced just below the chin, and were continued until within 14 feet of the tail, when they terminated abruptly, the posterior portion being even and smooth. The whole under surface was marbled with black and white, the latter colour being the most predominant. The fins were one on each side, oblong, flattened, white, the inferior margin undulated. They were 9 feet in length, and 30 inches in breath, and were articulated to the body about 11 or 12 feet from the anterior end, the greatest circumference being immediately in front of them. The tail was semi-lunar, and 9 feet in breadth. The individual was a female.

On opening the stomach six cormorants were found in it, and another in the throat, so that it was presumed this Whale had been choaked in the attempt to swallow the bird.

Whales of this description annually visit our coasts in the autumn, enticed from their proper residence in the north by the appearance of the herring fry, on which they chiefly prey. A few weeks previous to the above date, an individual, which measured 58 feet in length, was thrown on Holy Island; and a few years ago another, considerably larger, was exhibited at Eyemouth. They afford little oil in proportion to their size, and their whalebone is very short,—in this subject the longest did not exceed 15 inches,—so that the carcase is of little value. The one I have described sold for £17. 2*s.* 6*d.* The blubber was firm, nearly 4 inches in thickness, and yielded, I have been informed, about 18 gallons of very inferior oil.

The description, which corresponds most accurately with this Whale, is that of *Balæna Boops*, in Dr. Turton's *Compendium of the British Fauna*. It was first described as a visitant in our seas by Sir R. Sibbald, in 1690; afterwards in 1782, by Dr. Walker, and in 1808, by Mr. Neill. They were probably more common in ancient times, otherwise the grant which, in 1128, David I. conferred on the monks of Holyrood,

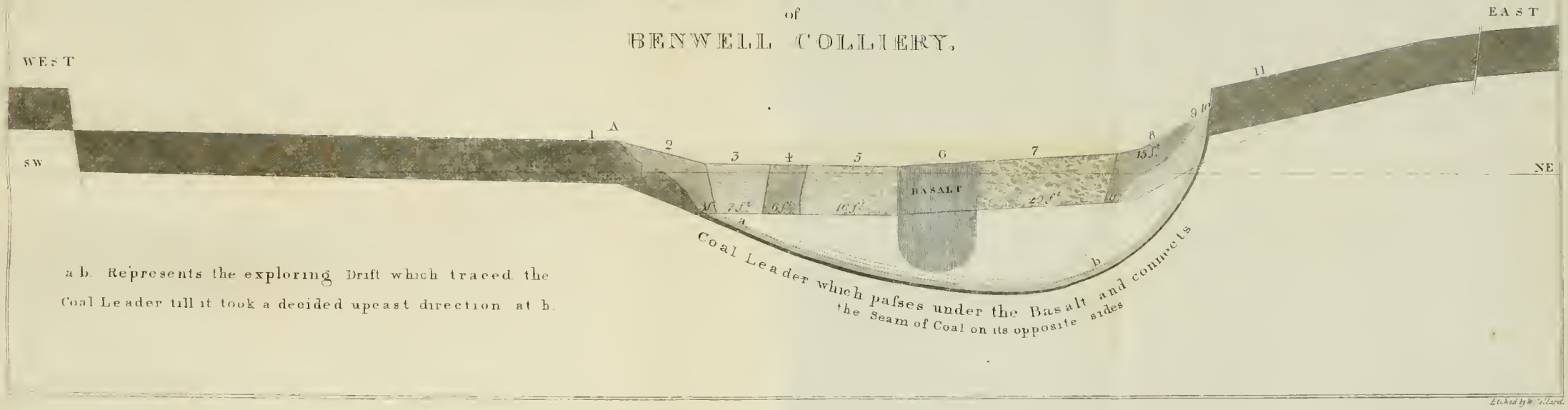
of the *tithe* "de omnibus cetis et marinis belluis qui mihi eveniunt ab Avon usque ad Colbrandspaith" (that is all along the southern shore of the Forth), would be next to worthless. The individual seen by Mr. Neill was 43 feet in length, and yet the fins, or swimmers, were only "nearly 5 feet long," and in breadth "did not extend to 1 foot." In this respect it agreed with the Whale described by Sibbald, but in that now noticed the proportions are very different, the length of the fins being one fourth the length of the body.

In the works to which I have access there is no figure of this species. I therefore accompany this communication with an accurate sketch of the animal, as it lay imbedded in the gravel, made by my friend the Rev. A. Baird.

November 1, 1829.

PLATE II

SECTION
of the
WHIN DYKE in the FENHAM DIVISION
of
BENWELL COLLIERY.



a b. Represents the exploring Drift which traced the Coal Leader till it took a decided upcast direction at b.

Etched by W. Willard.

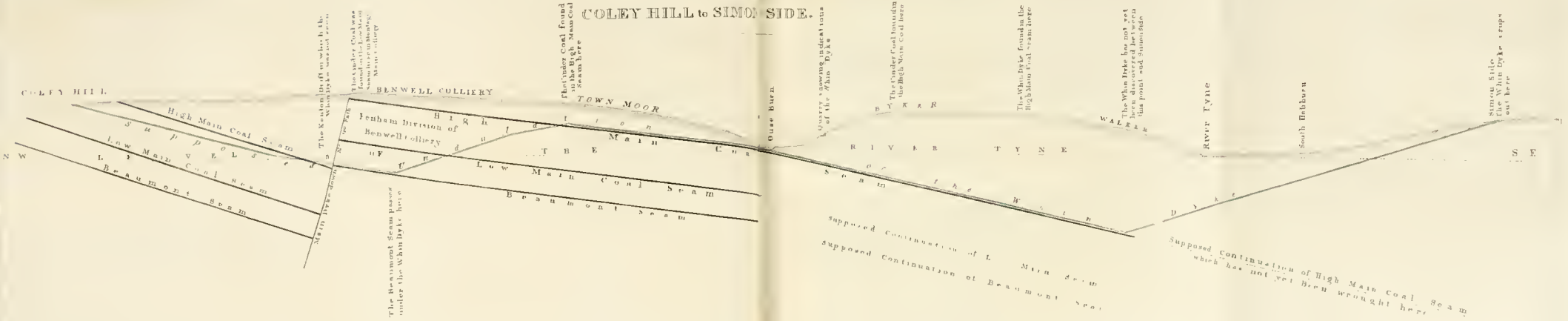
Diagram

to

ILLUSTRATE the supposed undulating structure of the WHIN DYKE

Taken in the Line of its direction from

COLEY HILL to SIMONSIDE.



PLAN of BENWELL COLLIERY

Shewing the course of the 90 Fath^m SLIP DYKE and of the WHIN DYKE lately discovered in the Fenham Division of that Colliery, also sundry other SLIP DYKES intersecting the Coal in various parts of the Royalty.

REFERENCE

aa. Slip Dyke down to N 90 fath.
bb Whin Dyke (S 45 E) 13 feet
cc. .....
dd Upcast to E 2½ Feet
ee. Upcast to E 8 Feet
f. Downcast to E 2 Feet.
g Upcast to E 2 Feet.
h Downcast to S 4 Feet
i Upcast to E 2 Feet
k Downcast to E 2 Feet
l Upcast to E 2 Feet
mm Downcast to E 14 Feet
nn Downcast to N 5 Feet.
o Downcast to N 1½ Feet
p Downcast to N 1 In
q .....
rr Upcast to N 18 Feet
ss. Upcast to N 14 Feet
tt. Upcast to N. 38 Feet
u Downcast to W unpr-oved
w Downcast to W 3 Feet
x. Drift as represented in the Section
z. Drift subsequently put through the DYKE in which the WHIN was found to be only 7 Feet thick

Downcast to North 90 Fathoms
EAST KENTON
Main Dyke
Supposed Line of Dyke S 45 E
NEWCASTLE TOWN MOOR
Railway
F E N H A M
Underground Railway
Fenham Hall
MAIN COLLIERY
Edward Pit
Quarry on Main Coal
Post
Road from Carlisle to Newcastle
Crop
B E N W E L L
Benwell and
Benwell Vil.
Charlotte Pit
Elswick Lane
Quarry
High Crofs
Main Post
of the Main Coal Seam
E L L
Beaumont Pit
Aubone Pit
Engine
Delavel Pit
Fisher Mans ho.
Scotswood Road to Newcastle
Staith
Kings meadows
NEWCASTLE
GUE MAIN MOUNTAIN
R I V E R T Y N E
Chain Bridge

Etched by W Collard

Scale 24 Chains to an Inch.

No. IV.—*Notice of a Whin Dyke lately discovered in the Fenham Division of Benwell Colliery.* *By* John Buddle, Esq.

Read, January 19, 1830.

The Dyke, which I am now about to describe, was first discovered in the workings of the Beaumont Seam, in the Montague Main Colliery, in the year 1795. At that time, it seems to have been considered as merely a branch from the main or 90-fathom Dyke, as appears by Mr. Winch's account of it, published in the 4th volume of the *Transactions of the Geological Society*.

At the time this Dyke was examined by Mr. Winch, the Whin, which lies in the heart of it, had not been discovered, the exploring drift having followed the leader of "sooty Coal," which passes under the Whin, to the upcast leader, on the opposite side of the Dyke; so that in this exploring drift the Whin was not seen, and the seam of Coal being found on the North East side of it, at 20 feet above the most depressed part of the coal leader, the Dyke was merely considered to be an ordinary upcast Slip Dyke of 20 feet. This description will be best understood by referring to the diagram, Plate II.

I received the above account of this Dyke from one of the workmen, Joseph Scott, who was employed in the exploring drift. And on following the leader of bad Coal in Benwell, until we arrived at the upcast, I concluded from the coincidence, that we had got the twenty-feet upcast Dyke of Montague Main Colliery.* I, therefore, commenced a stone drift at the point A. (*see* diagram, Plate II.) to be driven so as to cut the seam at the point, where we assumed it to be thrown up to by a Slip Dyke, 20 feet above the lowest part of the "*danty*" leader. The

* This Colliery ceased work in the year 1812. The Benwell drift through the Dyke is 500 yards distant from the drift in Montague Main Colliery.

course of the Dyke was found to be about South 45° East here, and the stone drift was driven in a line nearly at right angles to it; consequently, the stone drift, as shewn in the diagram, No. 1. gives a correct section of the Whin Dyke, and the strata lining its sides. The following is an account of the strata passed through by this stone drift, commencing at its Western End, *see* the diagram or section, Plate II., the roof of the seam being a bluesh-grey Metal.

	Thickness.
No. 1.—The seam changed into shattered Glance Coal, which is diminished in thickness from its full height, 3 feet 4 inches, into a mere leader by the descent of the blue-grey Metal roof. From the roof a tongue of the blue-grey Metal is protruded into the Coal.	
No. 2.—The blueish-grey Metal roof passing downwards, ...	3 feet.
No. 3.—Grey Post, intermixed with crystallized Carbonate of Lime, ...	7 —
No. 4.—Black Metal, much mixed with Coal, and semi-vitrified, ...	6 —
No. 5.—A singular rock, apparently composed of fragments of Shale or Metal Stone, the interstices being filled up with a fine white powder which is nearly pure Alumine, and Calcareous Spar; the Shale composing the substance of this rock, is entirely changed in its nature, differing very materially from the general character of this rock, as met with in our district,	16 —
No. 6.—Basalt, ...	13 —
No. 7.—Compact indurated black Metal Stone, ...	20 —
No. 8.—Black Metal, with scares of Coal, ...	15 —
No. 9.—The same as No. 3, ...	2 —
No. 10.—The same as No. 2, ...	6 inches.
No. 11.—Coal, same as No. 1.	

It may be worthy of notice that the Dyke has affected the strata on its South West side in a much greater degree than on the North East side, as No. 8 is evidently the same substance as No. 4, but not so much altered in its composition, and the Coal on the North East side resumes its natural state much nearer the Dyke. The most remarkable feature, however, is, that the Black Stone, No. 7, though in immediate contact with the Basalt, seems to be the least changed by the action of the Dyke.

This section shews clearly that the Whin Dyke does not pass through the Beaumont Seam at this place, but that it merely depresses the seam a few feet below its natural level, thinning it, as if by pressure, into a mere *leader*, and deteriorating the quality of the Coal.

On an old plan of the workings in the Low Main Seam in Montague Main Colliery, in my possession, a "Cinder Dyke" is represented, running in the same direction, and immediately above the line of the Whin Dyke, to which our attention is now directed.

The Low Main Seam lies about 30 fathoms above the Beaumont Seam, and I have no doubt but the "Cinder Dyke" described in the plan of the Low Main Coal Seam, is the same Dyke which we have found in the Beaumont Seam, as already described, or at least, that the Cinder Dyke is produced by the Whin Dyke below. I have no information as to whether any Whin was observed at this Cinder Dyke in the main coal. It is, therefore, a matter of doubt, whether the Whin extends upwards, from the Beaumont Seam to the Low Main Seam, or not; or whether its vertical extent is limited to the space between those two seams, which is about 30 fathoms.

No traces of the Whin Dyke have ever, to my knowledge, been observed on the surface here; it is, therefore, to be inferred that it does not pass through the whole of the strata, from the depth of the Beaumont Seam to the surface; and it is even questionable whether the Whin extends actually up into the Low Main Seam, although the Cinder Dyke, noticed in that seam, is undoubtedly caused by it. The Low Main Seam here lies at about 78 fathoms from the surface, and the Beaumont Seam lies 30 fathoms deeper.

This Whin Dyke may be said to rest upon the Beaumont Seam, as it does not actually pass through, but merely depresses and thins it, without actually coming in contact with the Coal; as the Black Metal Roof continued above the Coal, in the exploring drift *a b* (*see* section), till the upcast was met with: so that, in all probability, the Black Metal and other strata, which line the sides of the Whin Dyke, all interpose between the Coal and the Whin, in a compressed or thinned state, similar to the Coal, as shewn on the diagram.

As the Whin Dyke does not pass through the Beaumont Seam, we may infer that no traces of it will be found in the seams of Coals which lie below that seam.

This exhibition of a Whin Dyke shows it to be an exception to the

generally received opinion, that Whin Dykes have been formed by the Basalt, in a state of fusion, having been always forced upwards through the fissures, in the stratification from below, and that they extend to an indefinite depth. It might also shew, that it is doubtful whether these Basaltic fissures, which occur in various parts of the Newcastle Coal-Field, run through the strata in uninterrupted and continuous lines. Although this Dyke has only been proved, in Benwell and Montague Main Collieries, on the South side of the main Dyke, I am inclined to think, that it is a continuation of the line of the Coley Hill Dyke, which, after disappearing for a certain distance on the dip, or opposite side of the Main Dyke, near which it has not been traced, resumes its line of direction here, and proceeds nearly in a direct line through Newcastle Town Moor, by Sandyford Stone, Arkley Dean, Byker, and Lawson's Main, into Walker; through Walker, into South Hebburn, beyond which it has not been traced underground; but I consider it to make its appearance again at Simonside, at or about one and a half miles South from Jarrow Church, where the Basalt has been wrought out of it, in considerable quantities, for repairing the roads.

I shall now proceed to state the grounds, on which I have come to the conclusion, that this Dyke is a continuation of the Coley Hill Dyke, and that the Walker Dyke is a further continuation of the same. In short, that the Coley Hill Dyke extends from the Coley Hill to Simonside, where it appears at the surface, in a similar manner to that in which it presents itself at Coley Hill; the distance between these two points being, upon the line of the Dyke, about ten and a half miles. *See* the map, Plate III.

From the Coley Hill we do not discover any appearance of the Dyke at the surface, until we come to the Ouseburn; here, in the Freestone Quarry, on the East side of the Burn, the Stone, as well as the Clay and Earth above it, and also the debris, which covers the face of the bank from top to bottom, shew that the whole mass has been subjected to a high degree of heat; and several scattered fragments of Basalt, of various shapes and sizes, occur on the South side of the Quarry. From this point to Simonside, the Dyke never discovers itself at the surface,

although it has been found in the workings of Byker, Lawson's Main, and Walker Colliery.

I, therefore, assume, that it is not the character of this Dyke to shew itself frequently at the surface, but that it undulates in a *vertically serpentine* direction (*see* diagram, Plate IV.), the more elevated parts only, as at Coley Hill, Ouseburn, and Simonside, appearing at the surface. The more depressed parts descending to various depths, in different places, as will presently be shewn.

Under this view of its character, the non-appearance of the Dyke between Coley Hill and the points where it has been proved in Montague Main Colliery, and in Benwell, is the less extraordinary; and, it may be remarked, that that part of the country, in which no traces of it have been discovered, either on the surface or in the underground workings, is on the dip side of the Main Dyke, which depresses the stratification 90 fathoms below the level of the Beaumont Seam, in Montague Main and Benwell Collieries, where the Whin Dyke occurs.

Neither the Beaumont Seam nor the Low Main have yet been worked on the dip side of the Main Dyke, in the line of the Whin Dyke; we do not, therefore, know at present whether it intersects those seams or not in that part.

From the point in the Benwell workings, where we have crossed this Dyke, it runs in a South East direction into the Town Moor, through which, we have a traditionary account that a "Cinder Dyke" runs, which spoils the Coal in the High Main Seam for upwards of 100 yards in breadth, through the whole extent of the Moor, from near the Cow-gate to the Bull-park, on the East side of the Moor, where the Main Coal is not supposed to be more than 20 fathoms from the surface. The High Main Seam, it is to be remarked, lies about 65 fathoms above the Low Main, and 95 above the Beaumont Seam.

A pit, recently sunk and bored by Mr. Burdon Sanderson, at his Coal staith, near the North end of Brandling Place, to the High Main Seam, is in a nip of the Coal, which I consider to be occasioned by the Whin Dyke, and that this pit is sunk on the North side of it.

The next point, at which we discover any appearance of the Dyke, is

that already described in the quarry, on the East side of the Ouseburn. This quarry is at a point in the Eastern bank of the Dean, which juts out considerably, and lies about mid-way between Yellowley's Pottery and Rennoldson's Mill.

In the Arkley Dean, which lies about 200 yards further down the burn, to the South of this point, a pit was sunk a few years ago, to the High Main Coal Seam. At a few yards to the North of this pit, the workings terminated at the "Cinder Coal," on the South side of the Whin Dyke.

The High Main Coal Seam is in perfection at Rennoldson's Mill, although it crops out to the surface in the bed of the burn, at a short distance to the South of the Mill. But the Coal being found in a regular state in the pit, in Arkley Dean, and also at Rennoldson's Mill, and the North workings from that pit having been stopped by the Cinder Coal, shews clearly that the Dyke lies between these two points, even if its presence had not been proved by the appearances in the Stone quarry already described.

The next point at which we have any account of the Cinder Dyke, and which account is also traditionary, is at the Jane pit, in Old Byker Colliery. This pit was sunk close on the South side of the Dyke, and tradition states that it threw the main Coal seam down six fathoms to the North. I have been in the old workings of Byker Colliery, within about 100 yards to the North of this pit, and saw no appearance of Cinder Coal, in the accessible part of these workings, which shews that the Dyke cannot be of any great width here.

Proceeding onwards to the South East, the next point, where the Cinder Dyke was proved, was in the South West workings of the High Main Coal, in Lawson's Main Colliery.

These workings reached the North East side of the Dyke, and confirmed its supposed line of direction, from the points already described, into Walker Colliery, where its line of direction and other circumstances are accurately described in the 4th volume of the *Transactions of the Geological Society*, by Mr. Winch, from Mr. Geo. Hill's Communication.

From Walker Colliery the Dyke seems to run into South Hebburn; but it has not yet been discovered in any underground workings in that colliery, nor in any other, to the South Eastward of Walker. Indeed, no colliery workings, beyond Walker, have yet been extended far enough in that direction, to intersect it; and it is by no means improbable that it resumes its *ascent* in Walker, on approaching South Hebburn, so as to regain the surface at Simonside.

It is worthy of remark, that the Basalt, in the Walker Dyke, is stated to be 13 feet thick, being the same as we found it in Benwell Colliery. From the quarry at Simonside being filled up, the thickness of the Basalt there cannot be ascertained by inspection at this time; but the men, who worked it state that it crops out in Hedworth Burn, at which point they commenced working. They followed it to some distance, probably 50 yards, in a North West direction, in which distance it thickened from 6 to 11 feet. It dipped considerably to the North West, which, on account of the influx of water, stopped their operations.

From an examination of the map, and an attentive consideration of all the foregoing circumstances, it will, I think, be admitted, that we have strong grounds for concluding that the Dyke at Coley Hill, Montague Main, Benwell, Ouseburn, Lawson's Main, Walker, and Simonside, is the same; and that it may probably extend to a much greater distance, both to the South East and North West, than has yet been traced, owing to its undulating structure. For, assuming it to be at, or very near the surface at the Ouseburn, it does not again emerge to the North West till it reaches Coley Hill, nor to the South East till it reaches Simonside, the distance each way being five miles and a quarter. So that, if we assume this to be the law of its undulations, the next appearance of the Dyke to the North West would be five miles and a quarter further in that direction, and its next rising to the South East would be under the sea.

The greatest depth at which this Dyke has been found in Walker Colliery is about 105 fathoms below the Tyne level, and at Benwell its depth below the Tyne level is only between 30 and 40 fathoms; but, considering its depth relatively to the level of the seams of coal, taking

the Tyne High Main Seam, as the standard, it lies 100 fathoms deeper at Benwell than at Walker. The course of this Dyke is in the line of the full dip and rise of the strata.

Note. Since writing the foregoing account we have again drifted through this Dyke, at a point 144 yards further to the South East than the drift described in the section, Plate II. In this latter drift the only material difference which occurred in the Dyke, or its concomitants, was that the Basalt was only 7 feet thick, being 6 feet less than in the former drift.

Fig. 1.

Fig. 2.

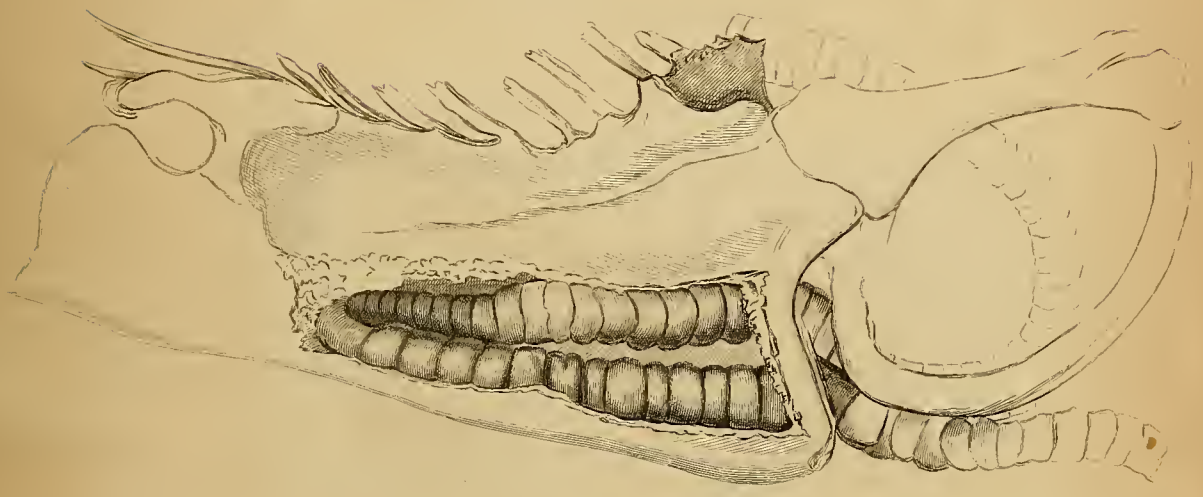


Fig. 3.

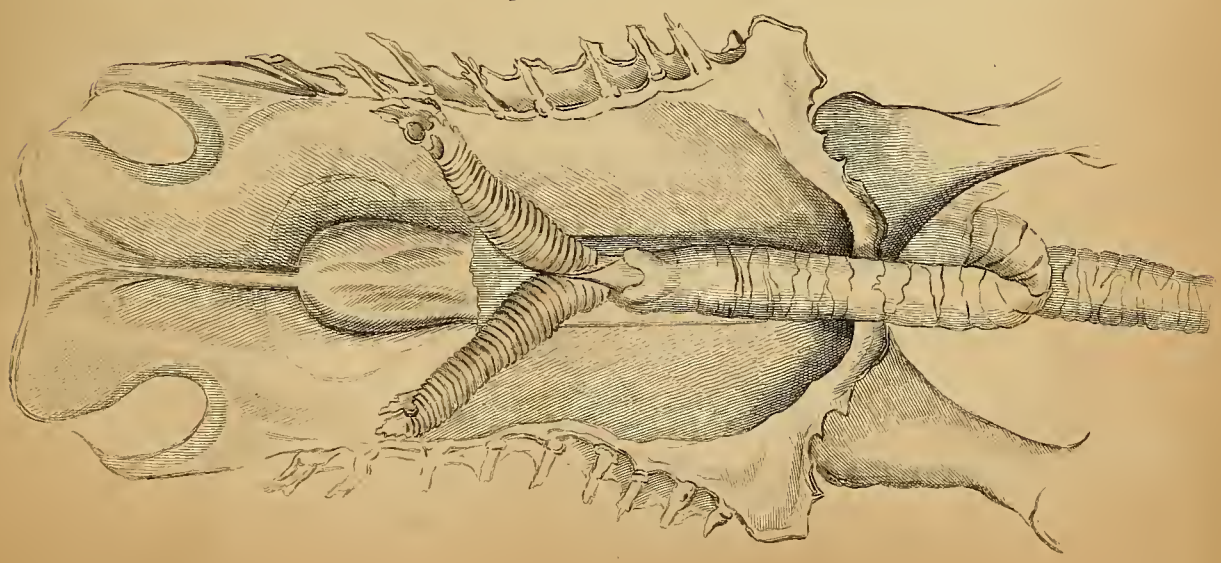


Fig. 1.

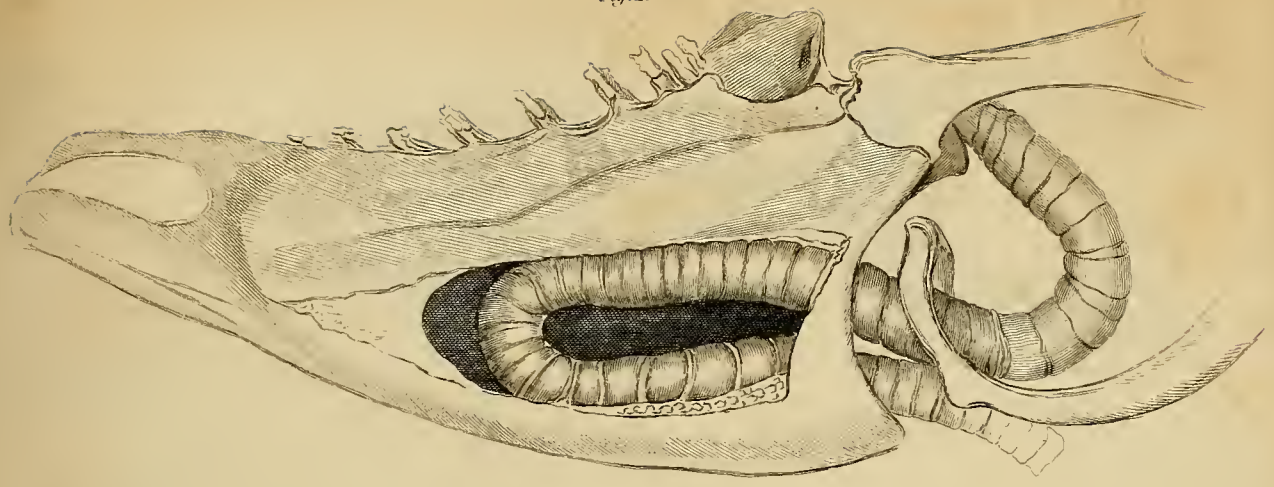


Fig. 2.

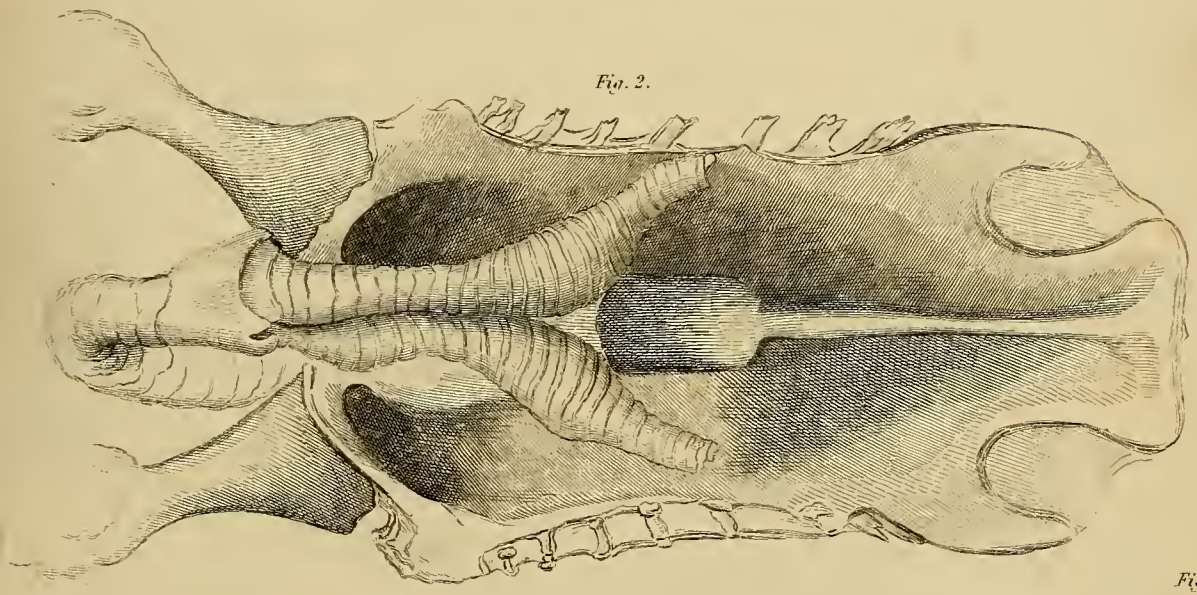


Fig. 5.

Fig. 4

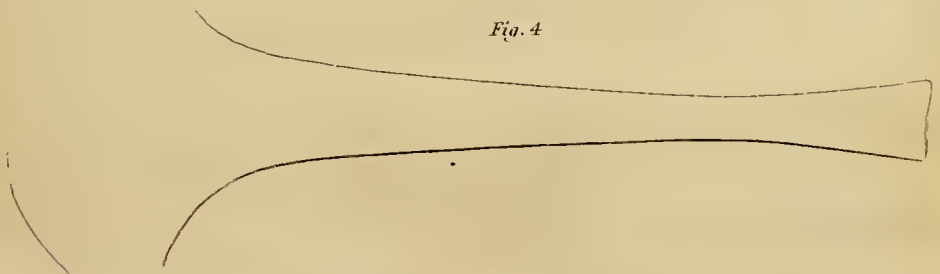


Fig. 6.

Fig. 8.

Fig. 3.

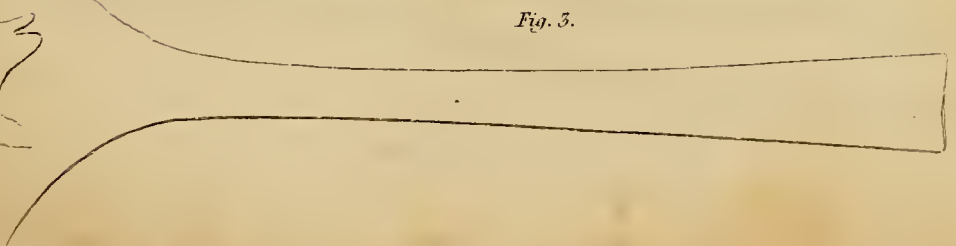


Fig. 7.

Fig. 2.

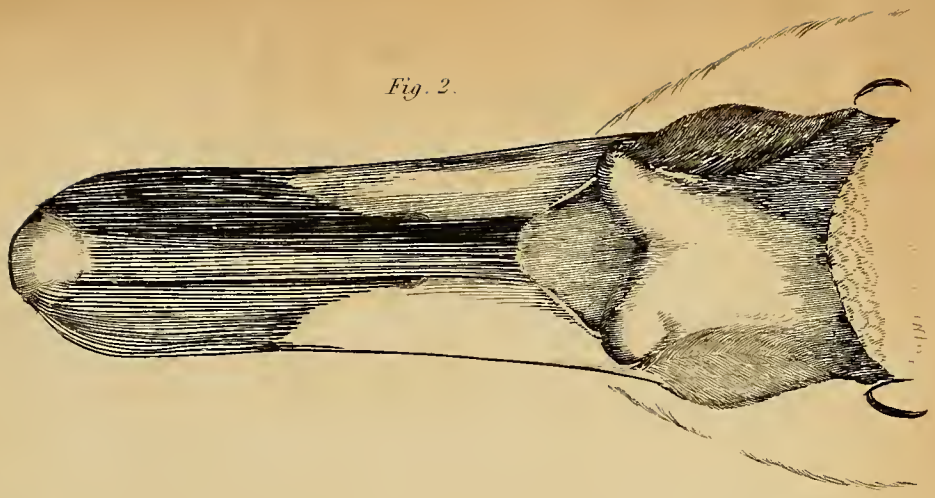


Fig. 1.

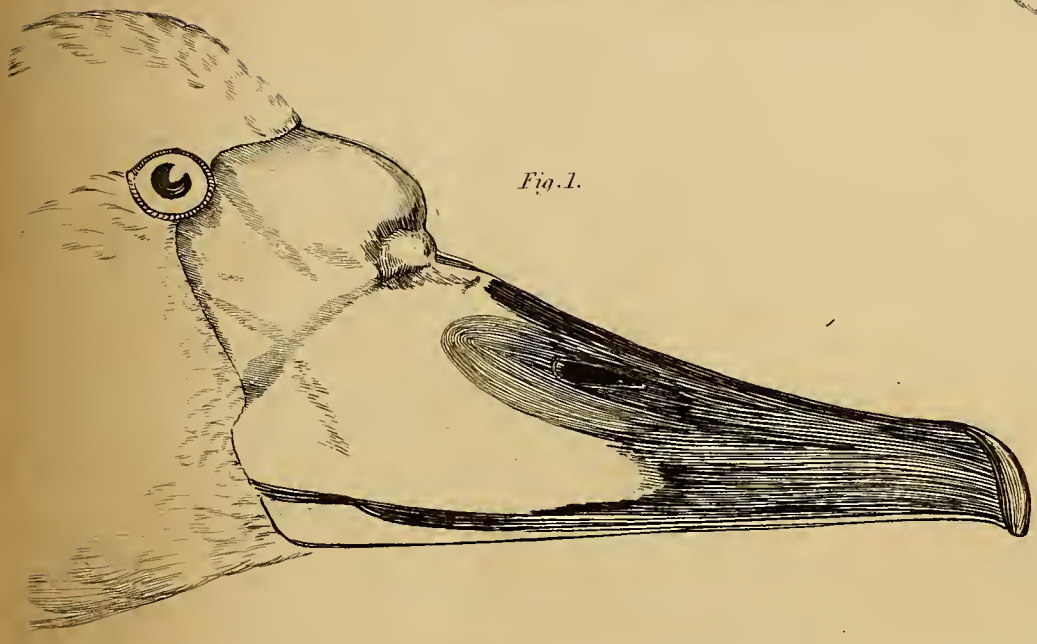
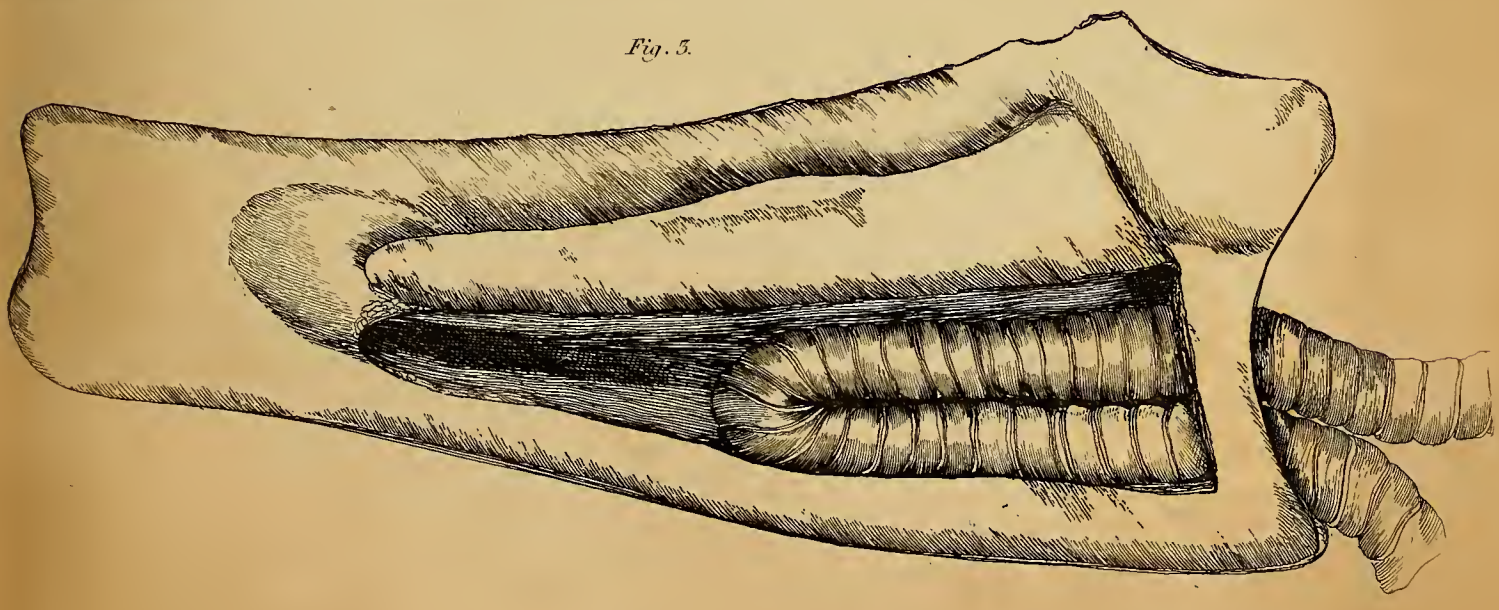


Fig. 3.



No. V.—*Observations on the new Species of Swan, discovered by* Mr. Richard Wingate, *of Newcastle upon Tyne, By* P. J. Selby, Esq., F. R. S. E., F. L. S., M. W. S., &c. &c.

Read February 16, 1830.

In submitting to the Society the following observations upon a new species of Swan lately discovered by Mr. Richard Wingate, it is far from my wish to interfere with, or in any way to detract from, the merit so justly due to him, as its first discoverer. The design of this paper, on the contrary, is to endeavour, by a more detailed account than has hitherto appeared, to prove the accuracy of his views, in considering it from the first as a species distinct from the common Wild Swan or Hooper *(Cygnus ferus)*, and that, as such, it ought, without further hesitation, to be added to the list of our native Fauna. To facilitate this it has happily been suggested, that it should receive the specific appellation of *Bewickii*, as a mark of respect, no more than due, to the memory of our late celebrated naturalist and engraver, Mr. Thomas Bewick, whose name must for ever remain associated, in the minds of all lovers of Natural History, with British Ornithology.

In arriving at a conclusion, in unison with Mr. Wingate, respecting this bird, I have been guided by a comparison and minute examination of the characters of the two species, not only as exhibited in their external form, but also their internal structure, upon which, as being constant and similar in individuals of the same species (except where accident has produced mal-formation), so much dependence may confidently be placed. In this examination I have been assisted by Sir Wm. Jardine, whose abilities, as a scientific naturalist, are generally admitted, and whose opinion, with respect to the subject now under consideration, coincides with my own. To Mr. Yarrell, also well known for his

attainments in various departments of Natural History, and his extensive knowledge in comparative anatomy, I am indebted for much information, and many acute remarks. I feel also great obligations to Mr. Geo. Atkinson, of Carr's Hill, for the information he has afforded, and also for his ready acquiescence in procuring, for comparison, the various parts of the two original birds upon which Mr. Wingate formed his species. Before proceeding to a comparative examination of the two species, or to detail the peculiar characteristics, external and internal, which distinguish the *Cygnus Bewickii* from the Hooper *(Cygnus ferus)*, it may not be out of place to enter into a detail of the events which led to the discovery, and to add such additional information as has since been obtained regarding its natural history. In the winter of 1828 and 1829, two Wild Swans, which afterwards proved male and female, one killed near Haydon Bridge, and the other at Prestwick Carr, in this county, were, fortunately for science, sent to Mr. Wingate to be preserved. The great inferiority of size they exhibited, as compared with the usual specimens of the adult Hooper, immediately struck him as remarkable; and further investigation discovered other marked distinctions in external form. Upon dissection, his opinion of their being a new species became confirmed, after observing the peculiar differences exhibited by these two birds in the conformation of that essential organ, the trachea, and the bronchial tubes, and also in the form of the sternum, as compared with the corresponding parts in the common Hooper. In consequence of the facts thus disclosed, Mr. Wingate shortly afterwards read a paper before the members of the Natural History Society of Newcastle,* stating the peculiarities of structure and form exhibited by those two birds, and giving it as his opinion that they were such as to entitle them to rank as a distinct and new species of *Cygnus*. The rare occurrence of the bird, which like its congener, the common Hooper, is with us a winter visitant, and as such is seen but occasionally, and even then in small numbers, and the want of further specimens that season prevented him from extending or renewing the observations he had made upon the two original birds, and consequently from establishing upon a

* See No. I. page 1.

yet firmer basis the correctness of the views he had advanced in his interesting notice. Enough, however, had been done to create an interest, and direct the attention of other naturalists to the facts thus disclosed, and it appears that in consequence of Mr. Wingate's paper and further communications from Mr. Atkinson, Mr. Yarrell entered into the subject with his characteristic ardour, and his investigations soon brought other facts to light, all tending in a greater or less degree to strengthen and confirm the views of the original discoverer.*

In a letter to Mr. Atkinson he has given a sketch of the sternum and part of the trachea of a Wild Swan in his possession (Pl. V. fig. 1), shewing the horizontal bend it takes at the posterior part of the hollow cavity of the keel, similar, though to a greater extent, to that of the female killed at Haydon Bridge, as shewn in Pl. V. fig. 2. The bronchi are also represented as very short, like those of the Newcastle birds, and a considerable portion of the trachea as well as the inferior larynx, or bone of divarication, enters within the internal cavity of the thorax, as it is shewn to do in the original specimens of *Cygnus Bewickii*, Pl. V. fig. 3. He also mentions having in his possession the sternum of a young female of the new sort, in which, although the trachea has not arrived at its full depth of insertion into the keel, still that part of the sternum destined to receive the horizontal curve is already excavated, in this respect exactly tallying with the appearance exhibited by the male of Wingate's bird, as shewn in Pl. VII. fig. 3. The bronchi of this are also short, and greatly inferior in calibre to those of the common Hooper, and he further states that Mr. Leadbitter, of Brewer Street, London, has seen three specimens of this new species, or, as he probably supposed, variety of Wild Swan, within the last five or six years. Shortly after this communication from Mr. Yarrell, a fortunate accident occurred, which gave that confirmation to the views of Mr. Wingate,

* Since writing the above, Mr. Yarrell informs me, that he has sent in a paper to the Linnæan Society upon the new Swan, illustrated by several drawings, and has described it under the specific name of *Cygnus Bewickii*. In this communication he mentions having obtained two fresh specimens of the new bird, one of which he has presented to the Linnæan Society, the other to the Zoological Society; and he has also discovered several other specimens in the collections of different individuals, some of them killed many years ago.

which, I have before stated, alone was wanting; this was the capture of seven Swans, all of the new species, which were killed by a right and left shot, upon Sweet-hope Lough, in November last, by the gamekeeper of Sir John Trevelyan, of Wallington. Two of these sent to Newcastle to be preserved exhibit the same striking peculiarities of outward form and internal structure as those possessed by the two original birds; and although in neither of them has the trachea arrived at its full depth of insertion in the cavity at the keel, still the cavity exists. The rest I am informed by Mr. Trevelyan were similar, and very little difference of size was observable among the whole of the seven birds.

In addition to the above, I may mention another fine specimen of this sort, lately presented to me, and killed in England last winter; and that I have in my collection a Swan, killed about 12 years ago upon Prestwick Carr, which evidently belongs to this species, as it possesses all the exterior characters, though the internal parts have been lost or neglected, and which remained until the disclosure of the preceding facts, marked as a small variety of the common Hooper. From the several specimens thus ascertained to have been killed in England, it would appear that this species has been in the habit of visiting our island for an indefinite period, though probably not in such numbers as the common Hooper. Its near affinity and close external resemblance to that species, have, no doubt, occasioned it to be long confounded with it, and though always inferior in size to old specimens of the adult Hooper, such a difference has been overlooked, or when noticed, attributed to accidental causes, or arising from age, sex, or climate. Such seems to have been the opinion of Montagu, for in his *Supplement to the Ornithological Dictionary*, he describes as the trachea of the adult male Hooper, what evidently must have belonged to a bird of the other species. This opinion of Montagu's, I find, is also adverted to by Mr. Cooke, in his description of the characters of the Whistling Swan, which he published in 1823, where, after referring to the passage in Montagu, he says, "this is a statement I have been anxious to establish or refute, but without satisfactory success. In the male specimen before me, and in many other male specimens which have been examined this season

by some eminent comparative anatomists, no such *sexual* difference has been observed. But after a long investigation at Brookes's unrivalled museum, in which he assisted me with zeal and friendship, I found a single sternum, presented to him by Dr. Leach with the very appearance described in the above quotation from Montagu." This sternum, considered at the time it was presented to Mr. Brookes, in all probability, as a mere variety of form in the anatomy of the Common Hooper, no doubt, had belonged to a bird of the newly-discovered species. So closely allied as it is both in outward form and internal structure to the Hooper, we may also presume that its economy is similar; of its peculiar habits, I cannot, however, speak particularly, where so few opportunities for observation have been afforded. It was, however, remarked, with respect to those killed at Sweet-hope Lough, that their voice or cry was very weak, differing very widely in this respect from the loud and sonorous call of the Hooper.* Mr. Yarrell has suggested the probability of its being one of the Swans mentioned by Hearne as visiting North America, for that traveller says, that the inhabitants of Hudson's Bay are visited by two kinds of wild Swans, one of which is more than a fourth less than the other.† This is a description which certainly accords with that of *Cygnus Bewickii*, and as both it and the other are known to the natives of the Arctic regions, it is not, perhaps, presuming too far to assume, that the two species, which visit that part of the new continent, are the same as those which resort to us during the severity of the Polar winter.

I shall now proceed to a detail of the various characters exhibited by the new species as compared with the corresponding parts of the Hooper, commencing with those of the exterior upon which it is usual to found specific description. From the measurement of the different specimens

* A fact, however, previously inferred by Mr. Wingate, from the difference of structure in the lower part of the trachea of the two species.

† Captain Franklin in the Journal of his second expedition to the Artic Regions, when residing at the station on the Great Bear Lake, during the winter of 1827, remarks (p. 307), "We welcomed the appearance of two large sized Swans on the 15th of April, as the harbingers of spring; and on the 20th of May, the small sized Swans were seen, which the traders considered the last of the migratory birds."

hitherto obtained or examined of *Cygnus Bewickii*, it appears to be about one-third less than the adult *Cygnus ferus*, the average length of the former being about 3 feet 11 inches, the breadth or extent of wing, 6 feet 8 inches;* that of the latter 5 feet or upwards in length, and about 8 feet in breadth. In the form of the bill there is a considerable difference, the base of the upper mandible of the new sort, at its junction with the cranium, being furnished with a protuberance or knob of greater or less size according to the age of the individuals, and in consequence only exhibiting a small portion of the lozenge shaped mark so conspicuous in the Hooper; it is also flatter, more dilated towards the tip, and the base or cere of a paler orange. The neck appears smaller in proportion, and does not swell downwards so rapidly as in the Hooper. The tail is more cuneiform, and contains only 18 feathers, whereas the Hooper has 20. The legs seem to be placed further backwards, or more out of the centre of gravity, and have not so large a naked space above the tarsal joint as those of the Hooper; and the lateral membrane of the inner toe of the new kind is broader and more deeply scalloped than the same part in the Hooper. Internally, the points of distinction exist in certain parts and proportions of the trachea and sternum. In old birds of the new species the trachea, after entering the excavation in the upright keel of the sternum, does not return by making a vertical curve or deflexion, as in the Hooper, but forms a horizontal bend or loop at the extremity of the excavation, as represented in Pl V. figs. 1 & 2, which excavation in this species not only extends to the extremity of the upright keel, but also occupies a part of the lateral portion of the sternum, Pl. V. fig. 1. This excavation, in the new species, is frequently upwards of 6 inches in depth, measuring from the anterior part of the keel, where the trachea first enters the cavity, to the posterior extremity of the same, where the recess is amplified for the reception of the orbicular loop; in

* The following are the measurements of four Swans of the new species:—

	Ft.	*Inch.*		*Ft.*	*Inch.*	
One killed at Prestwick Carr, January 1829, measured	3	11⅝	long,	6	8½	broad.
One shot at Sweet-hope Lough, Nov. 1829, do.	4	2	——	6	9	——
One shot at Ditto, ...	3	11⅝	——	6	8½	——
One shot at Haydon Bridge, 1829, female, ...	3	11½	——	6	5½	——

the Hooper it rarely exceeds four inches in depth, and never reaches the extremity of the keel, or occupies any portion of the lateral part of the sternum. In birds of a younger age, or which have not acquired the full developement of the tracheal tube, the loop, or horizontal bend, is much less, and does not occupy the whole of the orbicular portion of the cavity prepared for it, as shewn in Pl. V. fig. 2; and in still younger birds the trachea is seen to enter only a short way within the excavation of the keel, and then to make a vertical deflection, as in Pl. VII. fig. 3, although the cavity in that part of the sternum destined to receive the horizontal bend already exists and is partially excavated. In the new species, the keel does not project so far as in the Hooper, in consequence of which, the perpendicular depth of the cavity in that of the former is not so great, and the entering and returning portions of the trachea more compressed, or brought closer together, than the corresponding parts of the latter; the ridge of the keel in the two species is also different; in the Hooper narrowing from above downwards; in the new species, on the contrary, it becomes broader as it descends towards the extremity, where it is found considerably expanded, as in Pl. VI. figs. 3 & 4. The lateral portion of the sternum is also much wider in comparison to the size of the bird in the new species, than in the Hooper, and its general form and proportions appear very different when placed along side of each other. Tracing the trachea of the new species, after its egress from the hollow cavity of the keel, and the bend it makes on its approach to the thorax, a very marked difference becomes apparent at its lower portion, or where it is joined to the inferior larynx, or bone of divarication, to which are attached the bronchial tubes, as compared with the same parts in the Hooper. In the new species, the trachea itself, after describing the arch, enters a considerable way within the cavity of the thorax, as shewn in Pl. V. figs. 1 & 3, where it is joined to the inferior larynx or bone of divarication; at this part it swells considerably in volume, and its diameter, where it joins the larynx, is greater than at any other part of the trachea; the bone of divarication is also of considerable width (Pl. VI. fig. 5), its transverse diameter being more than double that of the Hooper, and its position within the thorax is vertical, as shewn in Pl. V. figs. 1 & 3. In

the Hooper, on the contrary, the tracheal tube does not enter the thorax, but, a little in advance, is joined to the inferior larynx, which is placed obliquely upon the anterior ridge of the sternum, or where the clavicles are articulated with it, as shewn in Pl. VI. fig. 2. This bone of divarication is very much compressed, (Pl. VI. fig. 6.) and, as I have before stated, not so much as half the diameter of that of the lesser species; in shape it very closely resembles the mouth piece of the bassoon, and the trachea, where it is attached to it, is greatly contracted and somewhat compressed (Pl. VI. fig. 7). This difference of formation, at such a peculiar part of the windpipe in the two species, very satisfactorily accounts for the dissimilarity of their note, as noticed in the flock at Sweet-hope Lough. In the form and size of the bronchi of the two species, there is also a marked and very essential difference, those of the new kind being very short, and scarcely measuring two inches in length (Pl. V. figs. 1 & 3); whereas the Hooper has them generally more than three inches long, with a diameter at the swollen part more than double that of the *C. Bewickii* as shewn in Pl. VI. fig. 2.

It must also be noted that the calibre of the whole of the trachea of the new kind is considerably inferior to that of the Hooper, and that the number of ribs differ in the two species, the Hooper having ten, the new species only nine on each side. Such, and I may add so marked, are the distinctions which present themselves upon a review and comparison of the parts of the two birds, and I think I may confidently add, that they are of sufficient magnitude to warrant Mr. Wingate's conclusions. Indeed they are as great as can well subsist between species of the same genus, for if greater, they would, according to the views of systematic arrangement entertained by naturalists of the present day, entitle the subject not merely to a specific but a generic distinction. In all the specimens of the new kind (and a considerable number have been examined), the peculiarities which distinguish them from the Hooper, are the same; they are all greatly inferior in size, all vary in the form of the bill, proportion of the wings, the shape of the tail, and the number of the rectrices; in all, the convolutions of the windpipe where it has attained its full developement,

are similar, particularly in the peculiar horizontal bend or loop it makes at the posterior part of the sternum; in all, the lower part of the tube is found enlarged, and the inferior larynx of considerable transverse diameter; in all, this part is suspended vertically, and considerably within the cavity of the thorax, and in all the bronchi are short and not more than one-third the dimensions of those of the Hooper.

I shall now conclude these observations, merely stating that this noble addition to our Fauna will hereafter stand recorded in our ornithological systems, as the *Cygnus Bewickii* of Wingate and may be thus characterised :—

Ordo Natores.

Fam. Anatidæ.

Genus CYGNUS.

Sp. *Cygnus Bewickii*, Wing.—*Bewick's Swan.*

Cygnus, albus, fronte genisque ferrugineo maculatis. Rostro basi tuberculo flavo, pedibus nigris. Cauda cuneata, rectricibus octodecim.

No. VI.—*A Catalogue of the Land and Fresh-water Testaceous Mollusca found in the Vicinity of Newcastle upon Tyne, with Remarks. By* Mr. Joshua Alder.

Read March 16, 1830.

The following Catalogue of a humble and inconspicuous, though not uninteresting, portion of our native animals, is now offered to this Society as a small contribution towards a Provincial Fauna. It will serve to shew a part of what has already been done towards ascertaining our indigenous *Mollusca*, and may be useful to the future inquirer by pointing out the habitats of many of the rarer species. It is hoped also that it may be the means of eliciting some further information on the subject; for the present list, drawn up principally from observations made in occasional rambles into the country during leisure hours, for the last three or four years, cannot be presumed to be complete.

Besides their local uses, Catalogues like the present, if founded upon a careful investigation of nature, will usually be found to record some new facts interesting to the general naturalist; some species perhaps not before observed, or some peculiarity in the habits and economy of those already known. They will, at the same time, always afford information with regard to the geographical distribution of the species, a branch of Natural History which has lately engaged particular attention, but which is as yet very imperfectly understood.

In tracing the distribution of the land and fresh-water *Mollusca* in this neighbourhood, we shall find them influenced, in some degree, by the geological features of the country. The greatest part of the district in which the following observations have been made, is composed of the series of strata usually called the Coal formation, joined, towards the south-east, by the Magnesian Limestone. The whole of this district

presents an undulated surface of hill and dale, frequently intersected by deep wooded dells, locally called *deans*. In these last, affording a plentiful supply of shade and moisture, the greater part of the land *Mollusca* are usually found: some species inhabit the roadsides and hedges; while a few, and only a few, are found in the more elevated situations. Many species occur in great abundance on the limestone, some of which are not to be met with in any other part of this neighbourhood. These are generally such as prefer a dry situation. Whether it is on this account only that they are found so abundant on this rock, or whether there is something in the limestone and its peculiar plants which is favourable to their growth and re-production it is difficult to determine. The quantity of lime necessary for the formation of their shell is secreted by these little animals in all situations, but it is not improbable that the secretion may be more readily effected where this material abounds.

Our sea banks also afford a favourite residence for numerous species. Of these the *Pupa marginata*, which is common amongst the scanty herbage of our sandy *links*, seems peculiar to such situations in this neighbourhood. Our rivers and streams are, for the most part, too rapid to be suitable for the habitation of the fluviatile *Mollusca*, and the quantity of marshy land in this part of the country is but small. As may be expected, therefore, the fresh-water species are not very numerous. Many which are of common occurrence in other places, are here very rare; *Paludina impura*, for instance, a shell which abounds in almost every ditch in many parts of England, is here a rare species, confined to one or two localities; while *Planorbis complanatus* and *contortus*, *Lymnæa stagnalis*, and *Physa fontinalis*, also common in the southern counties, have been here found only in one spot—Prestwick Car.

The proportion of the land to the fresh-water *Mollusca* in the British Fauna appears to be about 5 to 4. In Dr. Fleming's *British Animals*, the latest work on the subject, there are described, exclusive of the *Limacidæ*, 94 species; of these 53 are land, and 41 fresh-water. Mr. Miller, in the *Annals of Philosophy*, enumerates 60 species found in the environs of Bristol, 32 of which are land, and 28 fresh-water: and

the Rev. R. Sheppard's list of Suffolk shells, in the *Linnæan Society's Transactions*, contains 70 species—36 land, and 34 fresh-water. In the list now given for the vicinity of Newcastle, there are 71 species, of which 45 are land, and 26 fresh-water. It would thus appear that, while in the low lands of the southern counties the relative proportions of these subdivisions are nearly equal, in the more elevated tracts of the north they differ nearly as 2 to 1.

It may be thought by some that, by attending to minute distinctions, too many species have been introduced into the following Catalogue. It is well known, however, to every observer of nature how very small are the gradations by which species are often divided from each other, especially in the lower classes of animals, whose organisation, being more simple, affords fewer characters for specific distinction. Minute characters too, are seldom detected on a general survey, and thus in the progress of scientific inquiry, allied species are often confounded at first, which, on a more intimate acquaintance, it is found necessary to divide. Premising thus much, I submit the views of particular species here taken to the judgment of those most conversant with the subject, having at the same time the satisfaction of knowing that they are not without support from the opinions of some of our most eminent British Conchologists.

The habitats and localities here given, except in one or two instances that are mentioned, must be understood to rest upon the authority of my personal observation. My thanks, however, are due to my friends, Mr. Albany Hancock and Mr. John Thornhill, for the communication of many habitats, observed during their active investigation of this as well as other branches of the natural history of this neighbourhood.

CATALOGUE.

Class. Mollusca.

Order. Trachelipoda.

Fam. Peristomiana.

Gen. PALUDINA.

1. P. *impura*, Lam.
   Helix tentaculata, *Linn.*
   In ditches and ponds; rather rare. Prestwick Car, Haddrick's Mill-stream, Ouseburn.

Gen. VALVATA.

2. V. *piscinalis*, Lam.
   Turbo fontinalis, *Mont.*
   In ponds and slow streams; rare. Ouse Burn.
3. V. *cristata*, Mull.*
   V. planorbis, *Drap.*
   Helix cristata, *Mont.*
   In ditches and ponds; rare. Prestwick Car.

Fam. Lymnæana.

Gen. LYMNÆA.

4. L. *stagnalis*, Drap.
   Helix stagnalis, *Linn.*
   In ponds at Prestwick Car.
   A smaller and more slender variety of this shell also occurs as above, answering to the *Helix fragilis* of Montagu, who has most probably mistaken the Linnæan species.
5. L. *palustris*, Drap.
   Helix palustris, *Linn.*
   In ditches and marshes; not uncommon.
6. L. *leucostoma*, Lam.
   L. elongatus, *Drap.*
   Helix octanfracta, *Mont.*
   In ditches and ponds; frequent.
7. L. *minuta*, Drap.
   Helix fossaria, *Mont.*
   In ditches; common.

* The references to Muller's species have been made through the medium of other authors.

8. L. *peregra*, Drap.
   Helix peregra, *Mont.*
   H. putris, *Turt. Brit. Fauna.*
   In ponds and slow streams; common.
   I possess specimens of an elongated variety, collected on the Haughs at Redheugh. They answer to the description and figure of the shell published by Capt. Brown, in the *Wernerean Society's Transactions*, as the Linnæan *Helix limosa*.
9. L. *ovata*, Drap.
   The Rev. W. Mark informs me that he has lately found two specimens of this shell in a pond at Sandyford.

Gen. PHYSA.

10. P. *fontinalis*, Drap.
    Bulla fontinalis, *Linn.*
    In ditches at Prestwick Car.
11. P. *hypnorum*, Drap.
    Bulla hypnorum, *Linn.*
    In ponds and ditches; frequent.

Gen. PLANORBIS.

12. P. *contortus*, Mull., Drap.
    Helix contorta, *Linn.*
    In ditches at Prestwick Car.
13. P. *albus*, Mull.
    P. hispidus, *Drap.*
    Helix alba, *Mont.*
    In ponds and slow streams; frequent.
14. P. *imbricatus*, Mull., Drap.
    Turbo nautileus, *Linn.*
    In ponds, not uncommon.
    The crested variety (*P. cristatus*, Drap.) also frequently occurs.
15. P. *nitidus*, Mull., Lam.
    P. complanatus, *Drap.*
    Helix fontana, *Mont.*
    In a pond near Redheugh.
    This species, like the preceding, ejects a red liquid when disturbed: a similar secretion has long been observed in *P. corneus*, and is probably common to the whole genus.
16. P. *Vortex*, Mull., Drap.
    Helix Vortex, *Linn.*
    In ditches, common.
    Also the var. β *Drap.* (*Helix spirorbis*, Mont.)

17. P. *complanatus*, Flem.
P. marginatus, *Drap.*
H. complanata, *Linn.*
In ponds and ditches at Prestwick Car.

Fam. Colimacea.

Gen. AURICULA.

18. A. *minima*, Drap.
Turbo Carychium, *Mont.*
In moss, commmon.

Gen. SUCCINEA.

19. S. *amphibia*, Drap.
Helix succinea, *Mull.*
On plants in marshy places, frequent; generally in woods.
This includes the var. α and β, *Drap.* and is distinguished from the following species by the shell being rather stronger, smoother, and more shining; broader in proportion to its length; the whorls more rounded, and in having half a whorl more. Lip entire, even in young shells.

20. S. *oblonga*, Bean, MSS.
S. amphibia, var. γ and δ, *Drap.*
Shell transparent, shining, amber-coloured, oblong, slender, rather strongly wrinkled; with three flattish whorls, the first very large and much compressed towards its junction with the second; aperture oblong-oval, contracted at the upper angle; lip very thin and membranous, so as seldom to be found entire; length from 6 to 7 tenths of an inch, breadth one half its length.
A small variety only is found in this neighbourhood, on stones close to the edges of streams, and is most plentiful in the spring and early part of summer. It is not much more than half the size, more rugged, less transparent, and rather less compressed at the junction of the whorls, which leads to the supposition that it may turn out to be a distinct species. At present, however, I have followed the opinion of Mr. Bean in making it only a variety, and have also adopted the specific name communicated to me by that gentleman, for which he informs me he has the high authority of M. de Ferussac. This species is not, however, the *S. oblonga* of Draparnaud.

Gen. ACHATINA.

21. A. *acicula*, Lam.
Buccinum terrestre, *Mont.*
A single shell of this species was found on the sands at Tynemouth. From its delicate and fragile texture it could scarcely have been washed from a greater distance than the

adjoining banks. As I have not yet succeeded in finding it alive, its title to a place here may be considered as doubtful.

Gen. BULIMUS.

22. B. *obscurus*, Drap.

Helix obscura, *Mont.*

Under stones in old quarries and woods; most plentiful on a limestone soil.

23. B. *lubricus*, Drap.

Helix lubrica, *Mont.*

In moss; common.

Gen. AZECA.

24. A. *tridens*, Flem.

Turbo tridens, *Mont.*

On mossy banks in woods. Scotswood Dean and Meldon, Northumberland; and Causey Dean, near Tanfield, Durham. Very local, but generally found in abundance where it does occur.

The claim of this species to constitute the type of a distinct genus is disputed by some conchologists who are very properly averse to the multiplication of genera on slight characters. A careful examination of this curious shell, however, which has never yet been properly described, will prove that it cannot be included in any of the previously existing genera. It seems to form a link between *Bulimus* and *clausilia*, resembling the former in shape and general appearance, but approaching more nearly to the latter, in having the margin completely surrounding the aperture, and also more particularly in having a longitudinal plate on the columella considerably within the aperture, similar in situation, and making a slight approach in form, to the *Clausium* of the genus *Clausilia*, though attached through its whole length and inflexible. If it be thought necessary to change the trivial name of this species, on account of the smaller intermediate plaits, or teeth, (which however terminate in the larger ones in the form of a y,) the specific name of *britannica* proposed by Mr. Kenyon, seems preferable to the *Matoni* of Dr. Leach.

Gen. CLAUSILIA.

25. C. *bidens*, Drap.

Turbo laminatus, *Mont.*

Under stones in woods.

26. C. *rugosa*, Drap.

Turbo nigricans, *Turt. Brit. Fauna.*

On stones, trees, &c., in woods; frequent.

A larger and rather more ventricose variety occurs in old limestone quarries near West Boldon, and at Castle Eden, which has much the habit of a distinct species. The

curious, slender, and nearly smooth variety (*Clau. parvula*, Turt. in *Zool. Journ.* v. ii. p. 556,) is also found in Causey Dean, Tanfield.

Gen. BALEA.

27. B. *fragilis*, Gray, in *Zool. Journ.* v. i. p. 61.
Turbo perversus, *Mont.*
Castle Eden, Durham.

Gen. PUPA.

28. P. *edentula*, Flem.
P. muscorum, *Drap.?*
P. edentula, *Drap.?*
Vertigo cylindrica, *Ferussac?*
Amongst long grass in woods; not unfrequent.

This shell partakes of the characters of both *Pupa muscorum* and *edentula* of Draparnaud. It agrees with the former in being exactly cylindrical, with 6 or 7 whorls, and having the aperture, in old shells, slightly reflected. In none of the specimens I have had an opportunity of examining is there any indication of a tooth; but this, as in *Balea fragilis*, may only occasionally occur in very large and perfect specimens; and we are informed by Dr. Fleming, that Mr. Miller is in possession of a variety of this shell with "a very minute tooth on the pillar." Upon the whole, I am inclined to believe, that this is the true P. *muscorum* of Draparnaud, and that his P. *edentula* is either a variety of the same, or a species that we do not possess. The *Turbo muscorum* of Linnæus, like that of Montagu, probably included more than one species.

29. P. *marginata*, Drap.
P. muscorum, *Lam.*
Turbo Chrysalis, *Turt. Conch. Dict.*
On dry banks near the sea; frequent.

30. P. *umbilicata*, Drap.
P. muscorum, *Flem.*
Turbo muscorum, *Turt. Conch. Dict.*
Under stones, common; seldom in moss.

31. P. *anglica*.
Vertigo anglica, *Ferussac.*

Shell ovate-cylindrical, rather obtuse, horn-coloured, with 6 or 7 whorls, slightly striated; aperture sub-angulated, with 4 teeth running into the interior of the shell, 2 of which (the first large and the other small) are on the body whorl, one on the columella and one on the outer lip; lip thickened, reflected, and very much contracted towards the middle of the outer margin, where it is further thickened internally by a knob-like projection, so as nearly to meet the first tooth; umbilicus deep; length $\frac{1}{8}$th of an inch.

Animal, dark lead-colour above, and white below.

In moss and under stones; rather rare. Meldon, Walbottle Dean, and Cullercoats, Northumberland; and Castle Eden, Durham.

The internal structure of this shell is very curious and elaborate. It has a raised thread-like lamina running spirally round the columella in the manner of a corkscrew; and another similar lamina running spirally in the centre of the upper side of the whorls; opposite to this, across the lower side of the whorls, are set, at short distances, small, flat, testaceous plates, similar in situation to the septa in *Segmentina lineata*, Flem. (*Nautilus lacustris*, Mont.) This complicated structure is no doubt intended to answer some useful purpose in the economy of the animal, but what are its uses, besides the protection of the animal in a young state, I have not been able to discover. It is not continued through the lower whorls, and is most distinctly seen in young shells. The same curious structure is observable in P. *umbilicata*, but hitherto it seems to have escaped the observation of conchologists. P. *marginata*, which in its young state, is so very similar to the young of these two species, as to be otherwise scarcely distinguishable from them, is at once detected by the absence of this complicated structure. It is also entirely wanting in P. *edentula* and P. *sexdentata*. The internal structure of P. *pygmæa* and P. *Vertigo* I have not had an opportunity of examining.

32. P. *sexdentata*.

Turbo sexdentatus, *Mont.?*

Shell minute, ovate, sub-cylindrical, horn-coloured, very minutely and regularly striated; with 5 much rounded whorls, the penultimate one generally projecting a little beyond the rest; aperture semi-oval, contracted on the outer margin, with 6 teeth, 2 of which are on the body whorl, 2 on the pillar, and 2 on the outer lip; lip thickened, reflected, and generally having a rib, or rather swelling of the whorl, behind it; umbilicus moderately large; length about $\frac{1}{16}$th of an inch.

In wet moss in woods; rather rare.

This species differs from the P. *antivertigo* of Draparnaud in being smaller and with 1 tooth less on the body whorl. Dr. Fleming informs us that Montagu confounded two species in his *Turbo sexdentatus*, and as the present species is perhaps the only truly six-toothed British *Pupa*, it was probably one of them. I have, therefore, preserved the name as most appropriate, but being by no means certain that it is the shell described by Dr. Fleming under this name, I have thought it necessary to add a description. Dr. Fleming takes no notice of the striæ, and says that his shell has from 6 to 7 teeth, 3 of which are on the body lip. On a careful examination of at least fifty specimens, I cannot find that it ever has more than 6 teeth in the mature shell, and 5 in younger ones, 2 only being on the body whorl.

33. P. *pygmæa*, Drap.

Under stones in dry situations; rare. In old limestone quarries at Marsden and West Boldon.

Readily distinguished from the preceding by being rather larger, without striæ, and with only 4 teeth, 1 of which is on the body whorl.

34. P. *Vertigo*, Drap.

Vertigo pusilla, *Mull.*

Turbo Vertigo, *Mont.*

In moss; rare. Causey Dean, Tanfield.

A new genus was established by Muller for this species on the supposition that it had only two tentacula. Draparnaud, however, says that it has four, the two inferior ones being extremely short. In most of the species of this genus the upper tentacula are very long in proportion to the size of the animal: the lower ones, on the contrary, are very short, and not often protruded, so that, in a minute species like the present, they may be very easily overlooked.

Gen. HELIX.

35. H. *ericetorum*, Linn.

On banks and dry pastures near the sea; not unfrequent. Most plentiful on a limestone soil.

36. H. *virgata*, Mont.

H. variabilis, *Drap.*

In old quarries, on road sides, and sea banks, always on a limestone soil; rather local. Plentiful near Sunderland—*Mr. J. Thornhill.*

Three varieties occur: viz.

White, with a single broad band of chocolate brown above, and smaller ones beneath.

Brownish white, with faint interrupted bands.

White, with a transparent white band.

37. H. *caperata*, Mont.

H. striata, *Drap.*

On dry banks and in old quarries; common: sometimes on the trunks of trees. Most plentiful on limestone and near the sea.

I have a variety from Marsden with the whorls elevated so high as to give it the appearance of a *Trochus.*

38. H. *rotundata*, Mull, Drap.

H. radiata, *Mont.*

Under stones; common.

I have two or three specimens of a beautiful greenish white variety, collected in this neighbourhood.

39. H. *umbilicata*, Mont.

H. rupestris, *Drap.*

In old limestone quarries in exposed situations. Very plentiful in old quarries near the sea at Marsden.

40. H. *pygmæa*, Drap.

H. Kirbii, *Shep.* in *Linn. Trans.* v. xiv. p. 162.

Under decayed leaves, &c. in woods; not uncommon, but seldom observed on account of its colour and extremely small size.

Dr. Fleming has rather unaccountably referred this species to his H. *nitida*. It bears some resemblance to the young of H. *umbilicata*, but has more whorls in shells of the same size, and is much more finely striated. Their habitats, too, are entirely different.

41. H. *pulchella*, Mull, Drap.

H. paludosa, *Mont.*

In moss; rather local, and generally on lime-stone. West Boldon; and the ribbed variety (H. *costata*, Mull,—H. *crenella*, Mont.), at Marsden.

42. H. *aculeata*, Mull., Drap.

H. spinulosa, *Mont.*

In moss and under stones in woods; sparingly.

43. H. *scarburgensis*, Bean MSS.

H. holosericea, *Turt. MSS.*

Shell conical, rather globular, and depressed at the apex; pale yellowish horn-colour, with elevated striæ, giving the shell a silky or velvety lustre in certain positions of light; aperture contracted and sub-angular; lip simple; whorls 6, rounded; base convex; umbilicus large and deep; diameter not one line.

Animal pale grey.

Under decayed leaves in moist woods. Gibside Wood, Walbottle Dean, and Tanfield.

This beautiful little species was discovered some time ago by Mr. Bean, at Scarborough, which, I believe, was the only known locality, until I was so fortunate as to meet with it in the above places.

44. H. *Trochulus*, Mull.

H. trochiformis, *Mont.*

H. fulva, *Drap.?*

In moss and under stones in woods; frequent.

45. H. *crystallina*, Drap.

Shell flat, very shining, crystaline, white, with a faint tinge of green; whorls $4\frac{1}{2}$ or 5, smooth or slightly wrinkled; base rather flat; umbilicus small but deep; lip simple; diameter $\frac{1}{8}$th of an inch.

Animal, white, with two black lines on the back running into the tentacula.

In moss; common.

The shell lately published as new by Capt. Brown, in the *Edinburgh Journal of Natural and Geographical Science*," under the name of H. *vitrea* appears to be this species.

The confusion that has hitherto existed with respect to the species of *Helix* frequently confounded under the names of *nitens*, *nitida*, and *lucida*, has induced me to give the characters of these species at length, in the hope that, having paid attention to most of them in their native haunts, I may be able to clear up some part of the difficulty in discriminating them.

46. H. *pura*, mihi.

Shell depressed, rather shining, transparent, white, slightly striated or wrinkled; with 4 flattish whorls set diagonally; under side more shining than the upper, and without any appearance of opacity; umbilicus rather large; diameter less than 2 tenths or about 1 sixth of an inch.

Animal white, with 2 black lines like the preceding; cloak white, speckled with black.

A variety has the shell of a pale horn-colour, and the animal rather darker.

Under stones, decayed leaves, &c., in woods; not unfrequent.

This species somewhat resembles the preceding, but is readily distinguished from it by being larger, more convex, and less shining; the whorls less closely set, and the outer one larger in proportion to the rest. The umbilicus also is much larger. It has sometimes been taken for a variety of H. *nitidula*, but differs from that species in being scarcely one third the size, of a different colour, and without any trace of opacity underneath.

White varieties of this tribe of shells undoubtedly sometimes occur, but these are generally mere sports of nature, which, like similar varieties in the higher classes of animals are not perpetuated without the aid of art or domestication; such is not the case with this species, which preserves its characters unchanged even when living in the midst of its congenors.

47. H. *cellaria*, Mull., Lam.

H. nitida, *Drap.*

Shell flat, pale yellowish horn-colour, transparent, shining, very slightly wrinkled; with 5 or $5\frac{1}{2}$ whorls; the under side clouded with opaque white; umbilicus moderately large, scarcely exposing the second whorl; diameter 4 tenths of an inch.

Animal pale grey, white when young.

In cellars and yards, and also under stones in fields and woods; common.

This is the only species which is found in the habitations of man in the centre of large towns.

48. H. *alliaria*, Miller, in *Ann. Phil.* new series, v. iii. p. 379.

H. fœtida, *Stark*, in *Elem. Nat. Hist.* v. ii. p. 59.

H. nitida, *Shep.* in *Linn. Trans.* v. xiv. p. 160?

Shell nearly flat, slightly globular, thin, transparent, horn-coloured, very shining, nearly smooth; whorls 4; underside sometimes slightly tinged with opaque white; umbilicus rather large; diameter $\frac{1}{4}$ of an inch.

Variety of a transparent greenish white.

Animal black, emitting a strong smell of garlick.

Under stones, decayed leaves, and moss, in woods; common.

It differs from H. *cellaria* in being not above one-third the size, and more convex, in having the aperture less oblique, the umbilicus larger, and the white on the under side not so well defined.

From H. *nitidula* it differs in being smaller, and in its bright, glassy lustre and transparency.

The great peculiarity of this species, however, is the very strong odour which the animal never fails to emit when disturbed or irritated.

49. H. *nitidula*, Drap, Shep. in *Linn. Trans.* v. xiv, p. 160.

Shell nearly flat, deep yellowish horn-colour, sub-pellucid, rather strongly wrinkled, of a dull waxy appearance above, more shining below, except near the umbilicus, around which it is of an opaque white; whorls $4\frac{1}{2}$; umbilicus large, exposing the second whorl; diameter 3 tenths of an inch.

Animal, dark lead-colour.

Under stones by hedge sides, &c.; common.

Differs from H. *cellaria* in being smaller, rather more convex above and more concave beneath, of a duller lustre, darker colour, and more strongly wrinkled above; the umbilicus is larger and the aperture set at a less oblique angle. The opaque white also is not so much diffused over the base of the shell, but is confined to the margin of the umbilicus. The animal is of a darker colour.

50. H. *radiatula*, mihi.

Shell depressed, horn-coloured, rather shining, transparent, regularly striated; with $3\frac{1}{2}$ or 4 whorls, flattened at their junction with the inner ones, over which the striæ appear continuous and strongly marked, giving the shell a radiated appearance under a magnifier, the outer whorl rather large in proportion to the rest; underside smooth without any whiteness; umbilicus moderately large; diameter $1\frac{1}{2}$ tenth of an inch.

Animal black.

In wet moss; not uncommon.

This species may be distinguished from the young of the foregoing, to which it bears some resemblance, by the regular and more distinct striæ, and particularly by the flatness of the whorls at their junctions. The same characters also serve to divide it from the young of the two following species.

51. H. *lucida*, Drap.

H. nitida, *Lam.*

H. tenuis, *Dillw.*

Shell depressed, rather convex, thin, brownish horn-colour, transparent, shining, finely striated, whorls $4\frac{1}{2}$ or 5; umbilicus large, exposing the second whorl; aperture roundish; diameter $\frac{1}{4}$ of an inch.

Animal, jet black, giving the shell a dark chocolate appearance when alive.

In moist ditches and marshy places; rare. Heaton Dean.

It differs from H. *cellaria*, *alliaria*, and *nitidula*, in being more convex, more regularly striated, of a darker colour, and without any trace of opacity on the underside.

52. H. *excavata*, Bean MSS.

Shell sub-globular, depressed, shining, transparent, horn-coloured, regularly striated, whorls $5\frac{1}{2}$ or 6, rather rounded and closely set; base much rounded; umbilicus very

large and deep, exposing all the whorls to the top; aperture nearly orbicular except where it is interrupted by the body whorl; diameter nearly $\frac{1}{4}$ of an inch.

Animal lead-coloured.

Under decayed wood, and timber that has lain awhile on the ground; rare. Stella Dean and Gibside Wood.

This is anothor of the species for the discovery of which we are indebted to the indefatigable exertions of Mr. Bean. It was first observed in this neighbourhood by the Rev. W. Mark, in Stella Dean, and subsequently by myself in Gibside Wood. It very much resembles the preceding species, but may be distinguished from it by its greater convexity both above and below, and by its peculiarly large umbilicus; the whorls are also rather more convex and more closely set, and the outer whorl not so large in proportion to the rest; the striæ are rather stronger: the animal is lighter coloured and frequents a different situation.

53. H. *fusca*, Mont.

On brambles and other low plants in moist woods; not unfrequent.

54. H. *granulata*, Turt. MSS.

H. hispida, *Mont.*

On plants in woods; rather rare. Stella and Walbottle Deans.

This species proving different from the H. *hispida* of the Continental writers, I adopt the name for it communicated to me by Dr. Turton; to whom I am under great obligations for much interesting information on British shells. Mr. Kenyon has suggested that this may be the H. *sericea* of Draparnaud.

55. H. *hispida*, Drap.

H. rufescens, jun., *Mont.*

On plants in woods; common.

56. H. *rufescens*, Mont.

Under stones, &c.; rare. West Boldon.

57. H. *carthusiana*, Mull., Drap.

H. Cantiana, *Mont.*

On road sides and hedge banks; occasionally.

58. H. *hortensis*, Drap., Mont.

In woods and hedges; frequent.

A curious plain brown variety occurs at Stella, the lip being of a paler shade of the same colour, and rarely white.

59. H. *nemoralis*, Linn.

On hedge sides and sea banks; common.

60. H. *aspersa*, Mull., Drap.

H. hortensis, *Pen.*

In gardens and on hedge banks; common. Very abundant on dry banks near the sea on a limestone soil.

61. H. *arbustorum*, Linn.
In woods and on sea banks; frequent

Order. Gasteropoda.

Fam. Limaciana.*

Gen. VITRINA.

62. V. *pellucida*, Drap.
On plants and under stones in woods and shady places; frequent.

Fam. Calyptraciana.

Gen. ANCYLUS.

63. A. *fluviatilis*, Drap.
Patella lacustris, *Turt. Brit. Fauna.*
On stones in rivulets; common.

64. A. *lacustris*, Drap.
Patella oblonga. *Turt. Brit. Fauna.*
On the stems of aquatic plants in ditches and ponds; rather rare. Prestwick Car and in a pond between the Town Moor and Westgate Hill, Newcastle.

Order. Conchifera bimusculosa.

Fam. Naiada.

Gen. ANADON.

65. A. *anatinus*, Turt. *Biv. Brit.*
Mytilus anatinus, *Linn.*
In ponds; frequent.

Fam. Conchacea.

Gen. CYCLAS.

66. C. *cornea*, Lam.
C. rivalis, *Drap.*
Tellina cornea, *Linn.*
In ditches and ponds; common.

67. C. *lacustris*, Drap.
In ponds on and near the Town Moor, Newcastle.

* Not having paid sufficient attention to the naked Mollusca to give a satisfactory account of them, I have not included them in the present catalogue. The three common species of Limax, *ater*, *cinereus*, and *agrestis* occur here, but it is probable there are more British species than have been yet described. The subject requires further investigation.

My specimens agree pretty well with Draparnaud's description, but are less oblique and rather less compressed than his figures. I therefore acquiesce in Dr. Turton's opinion of their identity, with some slight doubts. The species is intermediate between C. *cornea* and C. *calyculata*.

68. C. *calyculata*, Drap.

C. lacustris, *Turt. Biv. Brit.*

Cardium lacustre, *Mont.?*

In ponds; rare. Carr-Hill, and Southwick—*Mr. A. Hancock.* Tynemouth—*the Rev. W. Mark.*

69. C. *fontinalis*, Drap.

C. pusilla, *Turt. Biv. Brit.*

Pera pulchella, *Leach, in Brit. Museum.*

In ponds and slow streams; not uncommon.

70. C. *gibba*.

Pera gibba, *Leach* in *Brit. Museum.*

Pisidium obtusale, *Brown*, in *Edin. Journ. of Nat. and Geograph. Science*, v. i. p. 412.

In ditches and ponds; frequent.

This shell is distinguished from the preceding by being smaller, more obtuse at the umbones, less triangular, more gibbous, and more slightly striated. The C. *obtusalis* of Lamarck appears to be distinct from this species.

71. C. *obliqua*, Lam.

C. palustris, *Drap.*

Cardium amnicum, *Mont.*

In streams; rare.

It may be proper here to mention that I have in my possession specimens of the young of *Helix cingenda*, Mont., given to me by my friend Mr. W. Robertson, who informs me that they were collected by him on the sea banks of Northumberland or Durham, but is not sure of the exact spot: certainly at one or other of the following places, Seaton Sluice, Bamborough, or Hawthorn-dean. Dead shells of *Cyclostoma elegans* and *Neritina fluviatilis* have also been found on our sea shores; but sufficient evidence of their being native has not been obtained to allow of their admission into the preceding Catalogue.

No. VII.—*A few Observations on the curious Mechanical Feats of a small Species of Spider. By the* Rev. William Turner.

Read January 19, 1830.

Although the subject of this short communication may, at first view, appear trifling, yet, as nothing is really so which is connected with the works of the Creator, whose wisdom is equally conspicuous in His minutest, as in His greatest, works, I trust that no apology will be needed for bringing it before the attention of the Society.

On the 1st of the present month, I attended, with several other gentlemen, the trial of a new Steam Engine, built by Mr. Robert Stephenson, for the Liverpool Railway; at the close of which our friend and associate, Mr. Mackreth, observed to me, that though Mr. S. was a great mechanic, he could shew me one still more extraordinary. On calling upon him the next morning, he brought out a tumbler glass, which he had inverted on the table over a sprig of a Laurustinus bush, on which he had observed a very small Spider. Supposing that it might want air, he had slipped under the edge of the glass a small roll of paper. In less than three days the little animal had filled the interior of the glass with minute, almost invisible, threads, by means of which, it had raised the sprig into the middle of the glass; and, not content with this, had raised also the coil of paper, which by some accident had slipped from under the edge: after this, it laid, upon one of the upper leaves, a large ball of eggs, and having thus completed the ultimate object of its existence, it died, and fell into the meshes of its own web. This glass, with its contents, I have now, by Mr. Mackreth's permission, the honour of exhibiting to the Society. How this little artist should have accomplished the herculean task of raising a weight several hundred times greater than itself, and for what purpose it should have done this, are questions

Lambert Sc.

which may well deserve consideration. I have not observed any similar feat recorded of Spiders in the volume on Insect Architecture in the *Library of Entertaining Knowledge.*

I believe that very little is as yet known of the great variety of Spiders and their operations. From a comparison of the individual in question with the very few figured by Donovan, it appears to be most like the *Aranea extensa*, vol. viii. p. 48. And as it is there said to be always found upon trees, and never upon the ground, this may be the reason why it has executed the arduous task of raising the branch on which it was confined to the upper part of the glass.

Mr. T. Sopwith has obligingly furnished the Society with a drawing of the glass and its content. (*See* Plate VIII.)

No. VIII.—*Notice on the Effects of a Basaltic Dyke, at Butterknowle Colliery, two Miles North West of Cockfield. By* Mr. Michael Forster, *Colliery Viewer.*

Read March 16, 1830.

The Basaltic Dyke, to which the following observations refer, is well known by the name of the "Cockfield Dyke," the thickness of which is from 18 to 20 yards, and its line of bearing nearly from east to west. By the intersection of other Dykes of considerable magnitude, near the point where the accompanying sections have been taken, the thickness of this great Basaltic Dyke is greatly diminished, and its line of bearing altered several degrees to the south of west. The observations, however, which I have the honour of laying before the Society at present, will be confined to the effects produced by this Dyke on the two seams of Coal which have been opened out under my superintendence, by the sinking of a pit called the William pit, at Butterknowle Colliery, the property of the Rev. W. L. Prattman, and situated about two miles to the north west of Cockfield.

I cannot better explain these appearances and effects than by relating them in the order in which our various operations brought us in contact with them. In driving forward the discovery drift A B (*see* Plate IX.) from the dip to the rise in the lower or Main Coal Seam, it was found that, within 11 yards of the Basaltic Dyke, the seam of Coal was displaced by a layer of Basalt and charred Coal, intimately mixed together, and having the same thickness and inclination as the seam itself. Of the appearance presented by this mixture a tolerably accurate idea may be formed by referring to the accompanying section, at C, where the Basaltic matter is coloured red, and the Coke, or charred Coal, dotted black. The charred Coal thus intermixed with the Basalt was so compact and hard (arising,

PLATE. IX.

SECTION shewing the Effects of the BASALTIC DYKE at BUTTERKNOWLE COLLIERY.

Line of Section from Dip to Rise & nearly at a Right Angle with the bearing of the Dykes

	Fms	Ft	In
Blue Metal with Post Girdles	13	4	
Black Metal Yard Coal Seam		2/3	7
Blue Metal & Plate	16	1	
Post	2		
Blue Metal with Post Girdles	6	3	
Five Quarter Seam	1		
Blue Metal with Post Girdles	3	2	
Post	1	2	6
Blue Metal	2	3	6
Post	1	2	
Hd Grey Metal with Post Girdles	3		6
Black Metal Main Coal Seam	1	2	6
	53	2	7

	Fms	Ft	In
Clay & Metal	1	2/2	
Grey Metal Yard Coal	2		
Grey Metal with Post Girdles	7	2	
Dark Grey Metal with Plate	1	2	
Post	2	2	
Pencil or Plate in thin Layers	1	3	6
Grey Metal	3	3	6
Post	5	1	
Dark Grey Metal	1		8
Coal Five Quarter Seam / Bed of Basalt	1	4	
Blue Metal with Post Girdles	2	3	
Grey Metal with Post Girdles	3		
Black & Grey Metal	1	3	
Post	1	4	6
Blue Metal with Post Girdles		4	
Black Metal	1	2	
Main Coal Seam	1		6
	39	3	8

Scale 9 Fathoms to an Inch.

Drawn by M Forster

Engraved by M.Lambert

doubtless, from the surrounding strata preventing the expansion which takes place in the *artificial* coking of Coal,) that it would have been nearly impracticable to have continued the drift through it; it was, therefore, found preferable to raise the drift into the superincumbent stratum of hard Metal Stone, intermixed with Sandstone, and in this stratum it was continued (having for its floor the mixed bed of Basalt and charred Coal), until it intersected the Basaltic Dyke (coloured red) at D.

Precisely at the point of contact between the stratum of hard grey Metal Stone and the Dyke, a leader of charred Coal was found, extending upwards from the mixture below, and penetrating the exterior crust of the Dyke, as represented by the specimen, No. 1. It is worthy of remark that, with regard to its position, this leader was precisely similar to those generally met with in common Dykes. The Dyke was found to be 2½ yards in thickness, underlying to the north about 15 inches per fathom, and composed of compact Basaltic matter. The strata were thrown upwards 2 fathoms on its south side, as represented in the section. No opportunity occurred of observing the effects of the Dyke on the Main Coal Seam, *adjoining* its south, or rise side, but the floor, or "*thill*," of the seam, through which the drift passed, did not appear to have been in any way affected by it.

At the distance of 10 feet from the Basaltic Dyke, a common Dyke (coloured brown in the section) was intersected by the drift, and found to be an upcast to the south, of 6 fathoms. This Dyke in every respect resembled those commonly met with in the Coal measures, nor did any thing in its appearance, indicate its proximity to the Basaltic Dyke. The drift was continued forward for about 40 yards beyond this 6-fathom Dyke, and the strata were found to follow their regular course without further interruption.

Subsequently to the driving of the drift, the sinking of the William pit was commenced on the south, or rise side, of these Dykes, and about 19 yards to the south of the point where the Basaltic Dyke reaches the surface. In the progress of sinking this pit, the beds of Sandstone, or Post, were found to have increased very much in thickness, as compared

with the same strata in the dip, or north side, of the Dykes, as will be seen by referring to the section. As similar changes of thickness take place, however, in many cases where the strata are broken or interrupted, it does not follow that the change here is at all connected with the Basaltic Dyke.

The Yard Coal Seam, which was cut at the depth of 1½ fathoms, did not appear at all affected by the Basaltic Dyke, yet on coming to the Five Quarter, or Crow Coal Seam, at the depth of 26½ fathoms, and at a horizontal distance of 32 yards from the Basaltic Dyke, a very remarkable appearance was presented; a bed of Coal, about 8 inches in thickness, extending over the whole of the bottom of the shaft, was immediately underlaid by a bed of compact charred, or carbonized, Coal and a bed of Basalt, abutting against each other, each of them being 10 feet thick, or about twice the thickness of the Five Quarter Seam. The relative position of these two beds will be better understood on referring to the section, where, it will be observed, that, at about one-third the distance from the dip, or north side of the shaft, the bed of carbonized Coal (dotted black), which doubtless represents the Five Quarter, or Crow Coal Seam, is entirely cut off, and its place occupied by a stratum of Basaltic matter (coloured red) of corresponding thickness and inclination, extending towards the rise. Between these two beds a perpendicular fissure, of about 3 inches in width, was found; its sides lined with crystals of Carbonate of Lime and Iron Pyrites. It is by no means the least remarkable feature in this stratified mass of Basaltic matter, that it occurs on the opposite side of the shaft, as contrasted with the Dyke; and it is also worthy of remark, that the 8-inch layer of Coal extends equally across both the Basalt and Coke, and appears to be very slightly, if at all, carbonized by its proximity to the Basaltic matter. There has been no opportunity of tracing the stratum of charred Coal towards the Dyke; hence the changes it may very probably undergo before it reaches that point, are unknown. With regard to its *stratification*, however, it may be fairly inferred that it will, like the Main Coal Seam and accompanying beds, be depressed by the 6-fathom Dyke, and it has been drawn on the section accordingly. How far the 10-feet

stratum of Basalt continues to hold the place of the Five Quarter Seam, towards the rise, is likewise unknown; but as the workings have been extended forward in that direction from the bottom of the pit, in the Main Coal Seam, for about 100 yards, in which no Dyke has been met with, it would certainly appear that this bed of Basalt can alone proceed from the Basaltic Dyke to the dip so frequently referred to. It only remains for me to add, that no appearance, which can be attributed to the influence of the Basaltic Dyke, has been observed in the Main Coal Seam, to the north of the shaft, although drifts have been driven from the pit in that direction for about 25 yards.

Butterknowle Colliery, near Staindrop, Feb. 13, 1830.

Observations on the Nature and Properties of several Specimens of Coal, Basalt and Coke, from the Vicinity of the Basaltic Dyke, at Butterknowle Colliery, described in the above Notice. By* Mr. Francis Forster, *Colliery Viewer.*

No. 1. From the mixed stratum of Basalt and Coke (C), at the point when it joins the Dyke. The Basalt in this specimen is of a light grey colour, very fine grained and compact, and interspersed with crystals of Felspar. Its specific gravity is 2·672. When submitted to a strong heat in an air furnace it loses about 8 per cent. in weight, and becomes fused into a brown glass. The Coke, or carbonized Coal, so intimately mixed with the Basalt in this specimen, is extremely hard and close grained—fracture uneven—colour grey—mixed with irregular streaks of Carbonate of Lime—and rather abundantly interspersed with Sulphuret of Iron. Its specific gravity is 1·957 (that of the Coal which it represents being 1·275). This Coke, when reduced to powder, and calcined in a strong red heat, leaves 23 per cent. of a heavy incombustible powder, of a reddish-brown colour. This residuum, when digested with nitric

* These Specimens were exhibited at the Meeting, and are deposited in the Society's Collection.

acid, and tested with prussiate of potass, and oxalate of ammonia, indicated the presence of Iron and Lime, the *former* in considerable abundance.

No. 2. Is a specimen of Basalt from the body of the Dyke where it was intersected by the discovery drift A B (*see* Plate IX.)—specific gravity 2·674—colour greyish-black—fracture imperfectly conchoidal.

No. 3. Specimen from the Main Coal Seam, near the bottom of the William pit—specific gravity 1·275. This Coal is of the very finest quality as a bituminous or coking Coal, very free from Sulphur, and well adapted for manufacturing purposes. It contains in 100 parts,

Carbon or Coke,	71
Volatile matter,	28
Incombustible earthy residuum,	1·1
	100·1

No. 4. Specimen from the 8-inch bed of Coal overlying the Basalt and Coke in the William pit. Specific gravity 1·254. Very inferior in lustre to the Main Coal, and containing a considerable proportion of Iron Pyrites. Bituminous, giving a large quantity of very fine gas, by distillation. It contains, in 100 parts,

Carbon or Coke,	64·7
Volatile matter,	34·
Incombustible earthy matter,	1·3
	100·0

It is very remarkable that this Coal should immediately repose upon, and be found in actual contact with, the 10-feet beds of Basalt and Coke, and yet retain all the above properties.

No. 5. Specimen from the 10-feet stratum of carbonized Coal in the William pit. Specific gravity 1·660. When calcined in a strong red heat there remained 35½ per cent. of a dirty-white, heavy powder, principally silicious, but containing a minute proportion of Iron. On its

first introduction into a strong heat, the powdered Coke emitted a feeble blue flame for a few seconds, but it may be observed that so great is the proportion of earthy matter, both in this Coke and the specimen from the Lower Seam, that they are equally unfit for the purposes of ordinary combustion.

Nos. 6 and 7, are specimens of Basalt from the 10-feet stratum in the William pit. Specific gravity of No. 6, 2·701 ; and of No. 7, 2·758.

Remarks. The proportion of incombustible earthy residuum existing in the carbonized Coal, from both seams, may, I think (in conjunction with the great pressure under which the process of coking would, in this instance, take place), be considered as very fairly accounting for the great specific gravity of the Coke as compared with the Coal. That *pressure* has very materially *assisted* in producing this effect, may be inferred from the great compactness and weight of the Coke, from the Lower or Main Coal Seam ; which, owing to its depth, would sustain a greater degree of compression than the Upper Seam, and hence, although its proportion of earthy matter is *less*, its specific gravity is *greater* than than that of the 10-feet stratum of Coke, representing the Upper Seam. With regard to the earthy residuum itself, its presence in so large a quantity appears difficult to account for ; unless, indeed, it may be supposed to be Basaltic matter, which has been infused into the cavities left by the escape of the volatile products of the Coal, when heated by its contiguity to the Dyke, and its contact with the Basalt, with which it is interstratified.

Newcastle upon Tyne, March 16, 1830.

No. IX.—*Remarks on the Distribution of the indigenous Plants of Northumberland and Durham, as connected with the Geological Structure of those Counties.* *By* Nat. John Winch.

Read April 20, 1830.

Of late years, some of the continental botanists have added to their Floras a geographical distribution of plants, and whoever has attentively perused the works of Wahlenberg, on the vegetable productions of Lapland, Sweden, Switzerland, and the Carpathian mountains, cannot fail to approve of the plan. In our own country another step has been taken to render the study of Botany more attractive and useful, by combining it with Geology; and an essay of considerable merit, drawn up for this object, forms a part of the preface of a well-written and amusing Flora, lately published by one of our associates, Dr. G. Johnston, of Berwick.* Mr. Hogg, of Peterhouse, Cambridge, had previously adopted a similar mode of illustrating this department of the Natural History of the vicinity of Stockton upon Tees, in an interesting tract appended to Brewster's *History* of that place, and a preface of the same purport serves as an introduction to Jones' and Kingston's *Flora Devoniensis*. After citing these authorities, I trust no further apology will be deemed necessary, for submitting to the Society the following remarks, which are intended to throw a small degree of light on two branches of the Natural History of this district. The notices offered, I allow, are as brief as perspicuity will admit, and the sketches slight; but at some future period, I trust it may be in my power to fill up the outline by details, useful in a practical point of view to naturalists, who may make the North of England the field of their botanical

* *A Flora of Berwick upon Tweed*, 2 vols. 12mo. by George Johnston, M.D., &c. &c.

and geological researches. In accordance with this plan, my first object will be to give a succinct description of the formations of rocky strata, and masses constituting the base of these counties, from the debris of which the diluvial soil chiefly has its origin.

From their antiquity, the crystalline rocks of Syenite, Greenstone, Porphyry, and Amygdaloid, of which the Cheviot group of mountains are composed, first lay claim to our attention. Whatever may have been the origin of these unstratified masses, their having assumed their present form at a very remote period cannot be doubted, for in places they are traversed by veins of Granite, and rocks of Grauwacke and the Old Red Sandstone rest upon them. Pitchstone has also been noticed among these hills, but never detected in *situ*. Cheviot is 2658, and Hedgehope 2347 feet high, but, notwitstanding their elevation, these mountains are not so propitious to the growth of rare plants as might be expected. The southern botanist, however, would not overlook *Saxifraga stellaris*, *Carex rigida*, *Epilobium alsinifolium*, *Epilobium angustifolium;* and here are our only localities for *Cornus suecica*, *Carex lævigata*, and *Rhodiola rosea*, though the latter has been found on Fast Castle, and in abundance, at the foot of a deep glen about a mile south of that spot, and on rocks between Lamberton and Barmouth, on the coast of Berwickshire—another instance of an alpine species re-appearing on the sea shore, common to a few other plants.

The Encrinal, Mountain, or Carboniferous Limestone, a formation of much greater extent and importance in every point of view, succeeds the Porphyritic mountains; it rises in the neighbourhood of Berwick, and skirts the sea shore for thirty-five miles, till covered by the Newcastle coal strata near the mouth of the river Coquet; if a line be drawn from this point, so as to cross the Tyne at Bywell, the Derwent near Allansford, the Wear below Wolsingham, and the Tees not far above Pierce Bridge, its Eastern boundary will be tolerably well defined; though the appearance of a stratum strongly resembling the Millstone Grit, one of its members, at Berwick Hill, near Mason Dinnington, might lead to the supposition of its intruding into the Coal-field, in that part of the line, further than had been conjectured. Towards

the West, it passes into Cumberland, and to the South, into Yorkshire, forming in these and the adjoining counties the English Apennines. As the beds of Encrinal Limestone only appear occasionally at the surface, being interstratified with rocks of Sandstone and Slate-clay, or Shale, the plants peculiar to calcareous soils are very partially distributed over its extent, but some of its mountains reaching to nearly three thousand feet in height, and beds of Limestone being uppermost, at many of these points, the richest Flora in England there presents itself. To confirm the assertion it is only necessary to enumerate *Kobresia caricina*, *Dryas octopetala*, *Thlaspi alpestre*, *Draba incana*, *Salix Croweana*, *Salix arenaria*, *Thalictrum alpinum*, *Cistus marifolius*, *Vaccinium uliginosum*, *Arbutus Uva-ursi*, *Tofieldia palustris*, *Malaxis paludosa*, *Saxifraga Hirculus*, *Potentilla fruticosa*, *Bartsia alpina*, *Carexca pillaris*, *Epilobium alsinifolium*,* *Epilobium alpinum*, *Gentiana verna*, and *Juncus triglumis*, as natives of the more alpine range of hills, while *Linnæa borealis*, *Trientalis europæa*, *Equisetum variegatum*, *Ornithogalum luteum*, and *Carex pauciflora*, occupy stations on the less elevated portion of this highly favoured botanic district. Nor should the Basaltic rocks, which partially bound the Northern coast, and pervade the whole tract of country under consideration, be overlooked, for on them flourish *Dianthus deltoides*, *Sedum anglicum*, *Potentilla alpestris*, *Potentilla verna*, *Aspidium Lonchitis*, *Woodsia ilvense*, and *Allium Schænoprasum*, a plant considered by many botanists a very doubtful native, but here certainly wild.†

In the Coal formation, Pontop-pike is the highest hill, being 1018 feet. From this point the ground declines gradually towards the coast, and near South Shields, begins to give place, or rather be covered by the Magnesian Limestone. The South-western extremity of the field is not very distant from Auckland, and its coast line from the Coquet to the Tyne may be reckoned at 24 miles. And here it may be worthy

* This elegant willow herb was lately added to the English Flora by W. C. Trevelyan Esq. of Wallington, who gathered it near the Cauldron Snout, in Teesdale.

† *Convallaria Polygonatum* is mentioned in the *English Flora* of Dr. Smith, v. ii. p. 155, to have been found on the Basaltic Crags at Kyloe, near Belford, by Mr. A. Bruce.

of remark, that in this formation, no stratum of Limestone intervenes between its Shales and Sandstones, no well authenticated marine exuviæ occur in its beds, nor do any overlying masses of Basalt occupy the surface, that species of rock being confined to the Dykes which traverse its measures.

Nearly the whole of this division of the country being of inconsiderable elevation, and chiefly in a state of cultivation, is of course unpropitious to the production of scarce plants; still several of the less common Ferns flourish in the recesses of the obscure and damp denes, while *Convallaria majalis*, *Pyrola media*, *Pyrola minor*, *Trollius europæus*, *Allium arenarium*, *Campanula latifolia*, *Vicia sylvatica*, *Andromeda polifolia*, and *Drosera anglica*, are found in the more open of its woods, its coppices, and bogs, and a greater variety of native Roses adorn the hedges, than are to be met with in any other part of the island.

Detached portions of the Magnesian Limestone may be noticed at Whitley, Cullercoats, and on Tynemouth Castle rock, but its regular course commences on the coast near South Shields, crossing the river Wear near Hilton Castle, the South turnpike road, at Ferry Hill, and the Tees in the vicinity of Pierce Bridge; and in its range southward is bounded on one side by the upper beds of the New Red Sand Stone, and on the other, by the Coal and Encrinal Limestone strata. No other description of rock intervening between its strata, though resting upon two interesting members of the New Red Sandstone, of which formation it should, in fact, be considered a part, and generally at no great depth below the soil, its influence on the vegetable productions of the tract are very obvious, for the plants peculiar to calcareous districts now become common, if not predominant; and here for the first time, *Tamus communis*, a plant of the South of Europe, and North of Africa, makes its appearance in woods and thickets. *Cypripedium Calceolus*, *Ophrys apifera*, *Ophrys muscifera*, *Epipactis ensifolia*, *Orchis ustulata*, and many more of this interesting order adorn the denes, the meadows, and pastures. Warden Law,* four miles west of Seaham, the highest Magnesian

* This hill is not Limestone at its summit, being capped by a very thick bed of Diluvium, among which may be noticed water-worn fragments, not only of rocks belonging the

Limestone hill being only 632 feet above the level of the sea, little or no difference can take place in the Flora, as far as elevation is concerned; but the arenaceous soil covering a space between Durham and Pittington, and which arises from the disintegration of a bed of very friable Sandstone, intervening between the Limestone rocks and Coal measures, certainly occasions a decrease of those vegetables peculiarly attached to calcareous soils.*

For a correct description of the New Red Sandstone district of the county of Durham we are indebted to the researches of Mr. Hogg, in the Essay previously noticed. The soil produced from the decomposition of its various strata covers the flat country bordering on the Tees, from the sea shore to the West of Darlington, and in breadth, from North to South, reaches from Stranton, in the neighbourhood of Hartlepool, to the foot of the Cleveland Hills, in Yorkshire. Whether, owing to the nature of the ground, many of its beds of Sandstone containing a considerable portion of calcareous matter, or more probably from the warm and sheltered situation of this South East corner of the county, we here meet with several species of Plants, strangers to other less favoured parts of the North; these are, *Bupleurum tenuissimum*, *Bupleurum rotundifolium*, *Cuscuta Epithymum*, *Rumex Hydrolapathum*, *Butomus umbellatus*, *Cladium Mariscus*, and *Sagittaria sagittifolia*. That their being indigenous in this spot cannot be attributed, entirely to the nature of the soil is evident, for the strata, which follow the course of the Tweed

Coal found in its vicinity, but of Encrinal, Limestone, Grauwacke, Greenstone, Porphyry, Hornblend Rock, Mica Slate, and Granite, the debris of distant mountains, situated far to the West and North-West.

* "*Bromus pinnatus*, *Festuca pinnata* of Smith's *English Flora*, is so characteristic of the thin and Magnesian soils, that in some instances where the lower Sandstone is brought by a fault to the exact level of the yellow Limestone (for example, on Bramham Moor,) the demarcation may be traced, with great exactness, by the help of this plant, without the assistance of a single excavation."—Sedgwick, in *Geological Transactions*, Second Series, vol. iii. p. 42.

I make no doubt that such is the case in Yorkshire and Nottinghamshire, but no botanist has detected the Spiked Heath Fescue Grass in Durham or Northumberland, nor is it a native of Scotland according to Hooker's *Flora Scotica*. This is remarkable, for the grass, in question is rigid in habit, and has all the appearance of a hardy plant.

to the West of Coldstream, are judged to belong to the same description of rocks, as those occupying the Eastern part of the vale of Tees, yet here only the ordinary vegetables of the low country are noticed, and not the natives of a more genial climate.

The line of sea coast from Tweed to Tees, including its sinuosities, cannot be less than ninety miles, and, in the course of this distance, rocky cliffs, of the five formations before mentioned, are laid bare to view. At their base, extensive tracts of sand bound the waves, and marine rocks of Sandstone, Basalt, and Limestone, covered by Algæ, are ranged beyond the beach. Here a rich collection of sea-side Plants awaits the botanist, and, though he may be disappointed that the beautiful *Lithospermum maritimum*, which, in Ray's time grew at Scremerston, near Berwick, has disappeared, yet *Ligusticum scoticum*, at Dunstanburgh, *Asperugo procumbens*, at Bamburgh, *Chironea littoralis*, *Sagina maritima*, and *Statice Limonium*, on Holy Island, certainly would not be passed by unnoticed. Farther South he will meet with *Geranium sanguineum*, *Astragalus hypoglottis*, *Thalictrum minus*, *Anchusa officinalis*, *Juncus maritimus*, *Convolvulus Soldanella*, *Rosa spinossissima*, *Rosa rubella*, *Elymus arenarius*, and *Eryngium maritimum;* and in the Magnesian Limestone caverns, *Asplenium marinum*. It should likewise be remarked, that many culinary vegetables, known to every one in our gardens, are here truly indigenous ; for instance, *Brassica oleracea*, on the North side of Tynemouth Castle rock, *Apium graveolens*, in salt marshes, *Pastinaca sativa*, on the Magnesian Limestone cliffs, and *Daucus Carota*, every where on the coast.

In conclusion, I may be allowed to remark, that the Flora of our district, in point of numbers and rarity of species, is one of the richest in England, comprising no fewer than two thousand two hundred and seventy-four well authenticated Plants, or at least such as are considered so by the most eminent botanists of the present day.

PHÆNOGAMOUS PLANTS.

DICOTYLEDONS.

ORDERS.	SPECIES.
1. Ranunculaceæ,	27
2 Berberideæ,	1
3. Nymphæaceæ,	3
4. Papaveraceæ,	7
5. Fumariaceæ,	4
6. Cruciferæ,	50
7. Violaceæ,	6
8. Cistineæ,	2
9. Droseraceæ,	2
10. Frankeniaceæ,	1
11. Polygaleæ,	1
12. Malvaceæ,	4
13. Hypericineæ,	8
14. Caryophylleæ,	36
15. Linæ,	4
16. Tiliaceæ,	3
17. Acerineæ,	2
18. Geraniaceæ,	14
19. Oxalideæ,	1
20. Portulaceæ,	1
21. Crassulaceæ,	9
22. Saxifrageæ,	9
23. Salicariæ,	2
24. Rhamneæ,	1
25. Ilicineæ,	1
26. Celastineæ,	1
27. Leguminosæ,	48
28. Rosaceæ,	50
29. Pomaceæ,	6
30. Grossulaceæ,	6
31. Onagrariæ,	9
32. Circæaceæ,	2
33. Halorageæ,	3
34. Umbelliferæ,	47
35. Stellatæ,	12
36. Caprifoliaceæ,	9
37. Lorantheæ,	1
38. Cucurbitaceæ,	1
39. Vaccineæ,	4
	398

ORDERS.	SPECIES.
	398
40. Campanulaceæ,	5
41. Lobeliaceæ,	1
42. Valerianeæ,	5
43. Dipsaceæ,	6
44. Compositæ,	92
45. Borragineæ,	19
46. Convolvulaceæ,	4
47. Plantagineæ,	6
48. Plumbagineæ,	2
49. Oleineæ,	2
50. Ericeæ,	6
51. Pyroleæ,	5
52. Apocyneæ,	1
53. Gentianeæ,	8
54. Solaneæ,	7
55. Primulaceæ,	14
56. Lentibulariæ,	4
57. Scrophularineæ,	31
58. Orobancheæ,	3
59. Melampyraceæ,	2
60. Verbenaceæ,	1
61. Labiateæ,	39
62. Thymeleæ,	2
63. Polygoneæ,	20
64. Amaranthaceæ,	1
65. Chenopodeæ,	23
66. Scleranthеæ,	2
67. Urticeæ,	5
68. Resedaceæ,	2
69. Euphorbiaceæ,	9
70. Empetreæ,	1
71. Ceratophylleæ,	1
72. Ulmaceæ,	6
73. Amentaceæ,	37
74. Cuculiferæ,	6
75. Coniferæ,	4
76. Myrticeæ,	1
77. Callitrichineæ,	2
	Species, 783

MONOCOTYLEDONES.

ORDERS.	SPECIES.
78. Aroideæ,	1
79. Typhaceæ,	5
80. Fluviales,	13
81. Pistiaceæ,	2
82. Juncagineæ,	2
83. Alismaceæ,	5
84. Hydrocharideæ,	2
85. Irideæ,	2
86. Orchideæ,	20
87. Melanthaceæ,	2
	54
88. Amaryllideæ,	4
89. Liliaceæ,	1
90. Asphodeleæ,	8
91. Smilaceæ,	6
92. Butomeæ,	1
93. Junceæ,	19
94. Cyperaceæ,	60
95. Gramineæ,	90
Species,	243

PHÆNOGAMOUS PLANTS.

ORDERS.		SPECIES.	
77	Dicotyledones,	783	
18	Monocotyledones,	243	
95			1026

CRYPTOGAMIC PLANTS.

Vascular—		
Characeæ,	5	
Equisetaceæ,	7	
Marsiliaceæ,	1	
Lycopodineæ,	4	
Filices,	25	
		42
Cellular—		
Musci,	179	
Hepaticæ,	45	
		224
Agames—		
Algæ,	179	
Lichenes,	281	
Hypoxyla,	80	
Fungi,	423	
Byssoideæ,	19	
	982	
		1248
	Species,	2274

No. X.—*Notice of a Bed of Whin, at Stanhope, in Weardale. By* W. C. Trevelyan, Esq., *of Wallington.*

Read April 20, 1830.

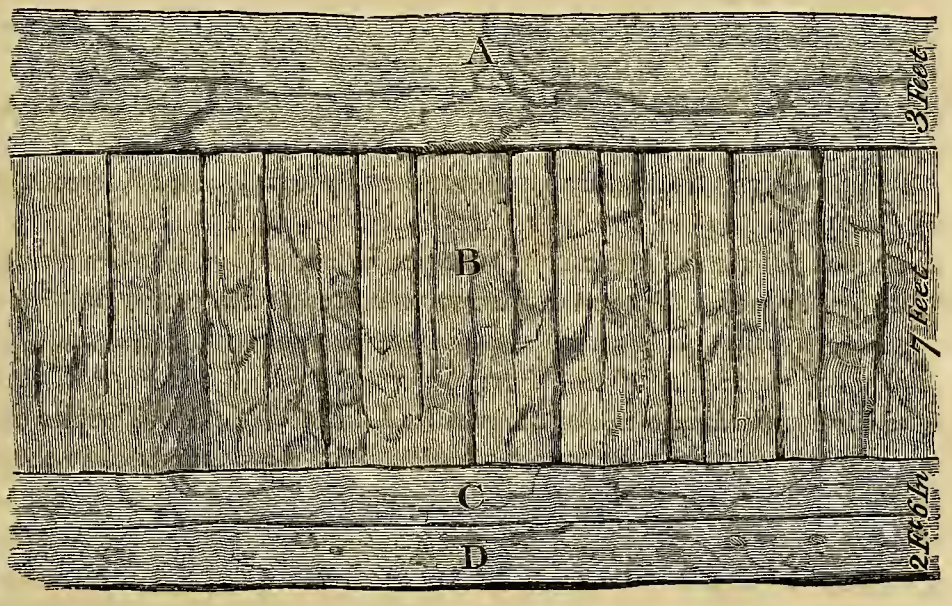
The bed of Whin which occurs in the Lead Measures at Stanhope, in Weardale, appearing to be unnoticed except by Westgarth Forster, in page 112 of his *Section of the Strata, &c.* 2d edition, where he has mistaken it for the great Whin-sill, which is much lower in the series (No. 192 of his *Section*); a short notice of it may, perhaps, be interesting.

This bed is first met with near Unthank Bridge, at the west end of Stanhope, where it forms, for some hundred yards, the bed of the river Wear, and rises on its banks in low picturesque columnar rocks. The thickness of it cannot here be ascertained, but, about half a mile to the west, in a burn, which, I think, is called Allergill, which runs into the Wear from the south, a good section is exposed, forming a picturesque waterfall, where it appears to be about 20 feet thick, and is superincumbent on a Limestone containing Pyrites, resembling that which occurs in the section in Rookhope Burn: from hence it may, I think, be traced by examining the beds of the burns as far west as Westenhope; and, on the north side of the Wear, it may also be followed almost continuously to Rookhope Burn, near Hole House, about three quarters of a mile above its junction with the Wear (where the section represented in the sketch occurs), it there is only 7 feet thick; from this decrease in its thickness, and from not having been able to trace it any further west, I am inclined to think that it is only of partial extent, as, indeed, supposing Whin to be of volcanic origin, and ejected from below (in favour of which theory there are many proofs), might naturally be expected.

This rock appears to occur in the fourth, or three-yard Lime (No. 163

of Forster's *Section*); it has, I believe, been sunk through in some of the Rookhope mines, and has been reached in Softlyside and other mines, near Stanhope, which Forster has erroneously stated (from supposing this to be the great Whin-sill) to be worked down to the Tyne-bottom Lime.

I hope I may have an opportunity this year of examining this bed again with more care, and shall be glad to communicate to the Society any further information I may be able to collect.



A SECTION OF THE STRATA IN ROOKHOPE BURN.

A. A bed of Limestone, of a dark grey colour, and splintery fracture, with minute specks of white Calcareous Spar, 3 feet thick.

B. Trap or Basalt, of a dark iron-grey colour, and fine-grained fracture, 7 feet thick.

C. Limestone altered by its contiguity to the Basalt; texture, crystalline; colour, grey and white mixed.

D. The lower part of the Limestone of a dark grey colour, and splintery fracture, with specks of Iron Pyrites, mixed through it.

No. XI.—*Notes on the New Red Sandstone of the County of Durham, below the Magnesian Limestone.* *By* Wm. Hutton, F. G. S., &c.

Read April 20, 1830.

Professor Sedgwick, in an elaborate paper just published in the *Transactions of the Geological Society*, has been the first to point out the true relations of a bed of Sandstone, found underlying the Magnesian Limestone and conformable to it, but unconformable to the Coal Measures.

This Sandstone had before been observed by Smith, who figures it in his *Geological Map of Yorkshire* (published in 1821), as the Pontefract Rock, but he mistakes its true nature and value, and classes it with the Coal Sandstones. Professor Sedgwick corrects this error, and very satisfactorily, upon a general view of the whole formation, from Nottingham to the banks of the Tyne, proves it to be a bed of New Red Sandstone subordinate to the Magnesian Limestone, and also points out its analogy with the "rothe-todte-liegende" of the German geologists; thus adding another link to the chain connecting the formations of this country with those of the Continent, and one which is of the more importance, as it serves to clear up many doubts and difficulties which have hitherto existed, in the comparison of our Strata with those of Germany.

In treating of the situation of Rocks on a district of great extent, it is absolutely necessary to consider the formations or usual groupings of certain beds, under their general and more prominent characters—in this way, of course, Professor Sedgwick has considered the strata under review, and has, in a very clear and comprehensive manner, pointed out their general relations; but when we examine the Geology of a small district, the different beds composing the formations cannot be

marked too minutely; and this more especially, when these beds possess any local interest, or economical value. The Sandstone beneath the Magnesian Limestone, besides being a member of our Strata, with which we were not before acquainted, is one of considerable importance to all the owners of property where it exists, particularly to all those who may have any intention of working Coal beneath it. Considering it in this view to deserve our attention, I beg to lay before the Society the following details of an examination of its edge, throughout the whole of the county of Durham, and the ideas that have suggested themselves by the survey, and this I do with the greater confidence, having had the advantage of the skill and professional experience of my friend, Mr. Francis Forster, along the whole of the line.

The beds composing the lower New Red Sandstone vary considerably both in mineral character and thickness, one great division may, however, be satisfactorily established, viz. an upper and a lower bed.

The upper bed is generally a running Sand, occasionally it may be considered as a Sandstone, but it never possesses coherence enough to be of use as a building material; it has interspersed through it, rounded grains of white Quartz, which occur very irregularly, but are often arranged in lines parallel to the planes of stratification, the prevailing colour is a very light buff. Between this and the lower bed, which is more consolidated, and of a red colour, the division is generally well marked, but sometimes the two pass into each other insensibly, the Sand gradually changing its hue, becoming compact and micaceous. The colour of the lower stratum is a character which varies exceedingly; it is at all times, more or less, red, sometimes purple; but almost every quarry furnishes beds, which, when taken alone, have little in their aspect to distinguish them from a common Coal Grit; sometimes it is light yellow, or nearly white with zones or bands of deep red, and frequently the colouring matter is in veins and spots. The characteristic colour of this Rock appears to arise from Oxyde of Iron disseminated through it, but this is frequently united with a clayey matter, forming nodules of "Ruddle," which are irregularly embedded in the Stone. The state in which Iron exists in this formation is different from that

of the Coal Measures generally—in no instance were we able to discover a nodule of Clay Ironstone, in the different beds composing it. The texture of the lower bed also varies considerably, it being sometimes of a fine even grain, and compact enough to be worked as a building stone; at other times, it is coarse and uneven, from the quantity and size of the embedded grains and nodules of Quartz. It is always micaceous, and some of its beds so much so, as to split into thin laminæ of a bright red colour, which are very prone to decomposition.

A conspicuous character of this lower stratum is, the false bedding of the Stone, which may be seen in every quarry; but, perhaps, the best character of all to distinguish it from a Coal Grit, is the total absence of vegetable organic remains.

This Sandstone, in the course of its outcrop, follows generally, that of the Magnesian Limestone, but occasionally projects beyond, where it is hard and of considerable thickness.

For the sake of perspicuity in the following remarks, we shall designate the upper bed as the yellow Sand, from its prevailing character, and the lower as the Red Sandstone; but without in the least wishing them to be considered in any other light than as different members of the same formation.

When the Magnesian Limestone first enters the county of Durham from the south, its course is so little marked for several miles from the lowness of the level at which it runs, that the beds beneath it cannot easily be examined—proceeding northward, however, it begins to rise into those round topped hills which form the general character of its edge throughout the county; the Red Sandstone keeps its course near the foot of these hills, and was first met with on the side of the road leading from *Legs Cross Toll Bar*, towards Heighington; about 100 yards beyond, the well-known Cockfield Dyke crosses the road; the Basalt, which has been worked for a road stone, is seen cutting through the yellow Sand.

Park House Quarry, on the hill side, one mile west of Heighington, is worked entirely in the Red Sandstone; it has been lately opened out; the Stone is of a close texture, and is used for gate-posts, &c.; the

Limestone is not seen in the quarry, but it forms the capping of the hill above, and is extensively worked about 300 yards to the east.

At *Brusselton*, near the top of the hill, close by the turn of the road, the yellow Sand is visible on the road side. In the great quarry beneath the tower, there is a very fine display of the Red Sandstone in all its variety of colour and texture, having beds or seams of a hard, light blue, siliceous Shale, running through it in the most irregular manner; the bed must be here of considerable thickness, as the quarry has been worked at least 50 feet deep.

In *Thickley Quarry*, by the side of the Darlington Railway, the same kind of stone is extensively worked, as is found at Park House Quarry and Brusselton. The upper bed is a Slaty Limestone; a light blueish white Clay occurs here in irregular seams. It was in a quarry a little to the east of this, by the side of the Railway, that the curious deposit of Fossil Fish occurred, which is described by Professor Sedgwick in his Memoir; they were found in a Slaty Limestone bed, very near the Sandstone.

At *Eldon*, the Limestone forms the top of the hill, and proceeding northward towards *Howlish Hall*, although the Red Sandstone does not appear at the surface, yet there is sufficient evidence of its existence beneath, in the deep rich red colour of the soil on the slope of the hills immediately under the Limestone.

At *Cowndon*, a fault, running nearly north and south, throws down the Limestone, so as to make it abut against the Coal Measures.

On the slope of the hill rising towards *Westerton*, near a well, in the middle of a large pasture field, the Red Sandstone comes to the day. At the top of the hill the true relations of the rocks are not easily understood; the east end of the village is upon Limestone, but there is a Sandstone at the surface in the road about 100 yards to the westward, which is no doubt caused by a fault. This Sandstone may be seen in a small quarry at the west end of the village; but whether it belongs to the Red Sandstone, or to the Coal Measures, is difficult to determine; it had large coarse grains of Quartz in it, apparently rounded by attrition.

The Limestone forms the top of the hill above *Quarrington*, below it

is the yellow Sand, and beneath this the Red Sandstone, which is here thin, and of the very micaceous variety. The upper part of the yellow Sand is hard, apparently from the infiltration of calcareous matter from the Limestone.

Heugh Hall Hill is principally of Limestone, but near the bottom of its northern slope, the Sand makes its appearance having bands of a red colour in it, marking the planes of stratification; in a field at the foot of the hill called "Red Brae Bank," the Red Sandstone has been lately bored through in search of Coal.

On the slope of the hill above *Pittington*, both members of this formation may be seen cropping out beneath the Limestone, but of inconsiderable thickness; the Sandstone is of the micaceous variety, splitting into thin leaves.

Near a Limestone quarry on the hill between *Pittington* and *Moorsley*, a thin bed of the same red micaceous shaly Sandstone appears, having above, or in it, a seam of blueish-white unctuous Clay. The quarry here is extensively worked in the slaty Limestone; a kiln is built upon the yellow Sand, which, at its upper part, has hard beds of a calcareous nature alternating with it.

The same light-coloured Clay is visible on the side of the footpath leading towards *Moorsley*, and still further on, about half a mile short of that place, the yellow Sand again appears beneath the Limestone.

At *Moorsley*, a new pit has been sunk by Mr. Russell, which was begun upon the yellow Sand, and immediately below the Limestone. The Sand is here about 16 feet thick, and the red Sandstone 3 fathoms, having a Shale bed beneath it.

In sinking the old pit, at *Hetton*, below the yellow Sand, the red Sandstone was found, between three and four fathoms thick, this bed is here well known and calculated upon by the sinkers, as unconformable to the Coal Measures, it having been proved by borings in search of Coal, in many places in the neighbourhood.

In the Downs Pit, at *Eppleton*, the sinking was through a dry yellow Sand, about six fathoms, and the Red Sandstone three fathoms.

The quarry, in *Rough Dean*, near *Houghton-le-Spring*, displays the

Slaty Limestone much mixed with seams of a yellow Clay, resting upon the Sand, sometimes in a very uneven line, the Limestone appearing to bend round and conform itself, to the inequalities of the Sand, which is of a light colour, having many hard veins of a calcareous nature in it, and also seams of Clay. It appears about 20 feet thick; there is at its lower part a bed of white coloured unctuous Clay, precisely similar to that observed between Moorsley and Pittington, and in the quarry at Thickley. The general character and appearance of the Red Sandstone, which is worked here as a building material, agree exactly with that of the Thickley, Brusselton, and Park House quarries.

The old quarry at the foot of *Houghton Hill*, which is worked down to the Sand, is, at its lower part, slaty, having thin layers of a brown Clay alternating with the Limestone. In a bed about 5 feet from the bottom of the quarry, a few impressions of Fish have been lately found, very well preserved, having their scales remaining perfect; the yellow Sand is here at least 60 feet thick.

The new pit, sunk by Lord Durham, at the foot of the hill was begun upon the Sand, and beneath it was a thin bed of Sandstone, of a brick-red colour, of a rough grain, and having white earthy Felspar disseminated through it.

At *Newbottle*, in consequence of a fault, the Limestone is thrown down, and made to abut against the Red Sandstone at the south end of the village; on the hill side, proceeding northward, a quarry is just opened in the Sandstone.

From this point towards Pensher Hill, although the rock is nowhere visible, the situation of the Sandstone is sufficiently marked, by the belt of red ground, formed at its outcrop, which may be thus easily traced by the eye beneath the Limestone.*

Pensher Hill, is well known as the most conspicuous point upon the

* The colour of the soil over the outcrop of the lower New Red Sandstone, which is more conspicuous in some parts than others, is a character to be observed generally; thus pointing out its situation, although the rock itself be not visible, and no doubt in this character have originated the names of several places upon the line; as Red-worth, Red-house, Red-brae-bank, &c.

edge of the Magnesian Limestone formation; the yellow Sand appears, exhibiting all its usual characters, on the northern face of the hill, about half-way down.

Clack's Heugh presents a very bold cliff of Limestone, resting upon the yellow Sand, here forming a bed of immense thickness; the Coal Measures are made to abut against the Limestone by a fault which traverses the eastern end of the cliff; and a portion of the Red Sandstone has also been forced up, so as to form the uppermost bed. This is the only point at which I have observed it on the south bank of the Wear, although I am informed it exists higher up, near to *Hylton Ferry;* on the opposite side, however, it forms a most conspicuous object, being there of great thickness, and generally of a dark reddish purple colour, the yellow Sand forming its upper member. Above *Burn's Quay* is a quarry where it is worked for fire-stone; it is close-grained, but not very hard, and of a pretty even texture.

In the great *Pallion Quarry* the Limestone is worked more than 60 feet thick; the lower Slaty beds are of a blueish-grey colour, and being found to make good Lime (probably from the absence of Magnesia), they are worked entirely away; they are found to rest upon what the quarrymen call "Black Stone;" a tough brown Shale about 7 feet thick, and below this the yellow Sand occurs to an unknown depth. It was in the lower beds of the Limestone, in this quarry, that the Fossil Fish occurred, which is figured in the 4th vol. of the *Geological Transactions*, Plate II.

In the little dell running up from the Wear towards *Hylton Castle*, the yellow Sand may be observed, beneath the Limestone, of considerable thickness.

At *Down Hill*, near West Boldon, we again have the Sand; it cannot be seen in the quarry, but makes its appearance at each end of the escarpment beneath the slaty beds of the Limestone; a single Fossil Fish has occurred in this quarry.

In *West Boldon*, Limestone is worked on the hill, below the Church; in the quarry the yellow Sand is not visible, but, it appeared, in cutting the foundations of a house below, and a well not far from the gate of the Rectory was begun in it; this bed must here be of inconsiderable

thickness, as the Red Sandstone was immediately come upon, and was sunk into to the depth of 29 feet; the upper part was micaceous, splitting into thin layers, but the stone became more compact as the operations were carried deeper.

In a little dell near *Westoe*, called the *Deans*, behind a house called Brinkburn House, the Red Sandstone occurs, and I am informed by a gentleman well acquainted with the neighbourhood, that some years ago the yellow Sand was worked in a pit near to *Harton Toll Bar*, on the turnpike road from South Shields to Sunderland. At the mouth of the above-mentioned dean, near a brewery, a Sandstone of the Coal Measures is visible, on the western side of the burn; rising to the top of the hill, on the opposite side, we find the New Red Sandstone, in *Mr. Fox's quarry*, which has been extensively worked for a building stone; it may be again seen in the *Colliery Quarry*, on the road side leading to *Westoe*. The Magnesian Limestone, which forms the capping of the hill, being also worked in an adjoining field.

In a quarry at *Lay Gate*, near South Shields, the Red Sandstone forms the upper bed, and rests upon a white Sandstone, which is evidently, from its general characters, a Coal Grit, having abundance of vegetable remains in it. This quarry was the last point at which the red rock was observed South of the Tyne; but on the north side it occurs again, forming the cliffs below the *Spanish Battery*. Here neither the Limestone nor the yellow Sand appear, but on the other side of *Tynemouth Haven* the Limestone forms the uppermost bed in the *Castle Cliff*, and at its lower part alternates with the yellow Sand; the latter is upwards of 20 feet thick, and is seen resting upon the Red Sandstone, which forms the whole of the lower part of the cliff on its south and eastern faces.

A well-known Basaltic Dyke here cuts through the red Sandstone, and the yellow Sand, but is not seen in contact with the Limestone. In the eastern face of the Cliff, several faults appear traversing and affecting alike the whole formation.

At the base of the cliff, on the northern side, in *Percy Haven*, a Coal Sandstone makes its appearance, rising rapidly towards the north-west, being surmounted by the superior formation; both members of which

may be traced all round this haven, and extending to a point a little short of the *Two Gun Battery*, where they are cut out by the rising of the beds of the Coal formation.

At the South point of *Cullercoats Haven*, the great, or 90-fathom Dyke, as it is called, again brings down the Magnesian Limestone and the yellow Sand. The Dyke may be seen in the cliff, near the South point of the Haven, where a Coal Sandstone, and a bed of Shale form its high, or southern cheek, and the yellow Sand (here a soft Sandstone) the northern. The Dyke hades, or underlies about 38° to the north, and its direction is N. 87° W. Its course towards the sea may be traced without difficulty, at low water, for a considerable distance eastward, the well-known Sandstone rock, called the "*Bear's Back*," forming its southern side, and the yellow Sand having many thin beds of Magnesian Limestone alternating with it, the northern. These alternating beds of Limestone and Sand show marks of considerable mechanical force, being bent and contorted near the edge of the Dyke. Within the bay a bed of Shale is exposed to view, which here forms the southern cheek of the Dyke, in consequence of the action of the sea having removed the whole of the yellow Sand, except at the south-eastern point, where the curved beds of Limestone may be again seen alternating with the Sand, as well as in the cliff below the Fishermen's Beacon.*

From the appearances at this point it cannot be doubted that the Dyke has thrown down the Magnesian Limestone, as Professor Sedgwick observes, and it also follows, as a matter of course, that the Limestone at *Whitley Quarry*, upon the course of the Dyke, is similarly affected. A close examination of the quarry, last autumn, convinced me that such was the fact; the operations of the quarrymen had removed, in one spot, the whole of the Limestone, and laid bare, for a considerable distance, the southern cheek of the Dyke, which was here, as in the Haven

* In Professor Sedgwick's *Section (Geol. Trans.* 2d Series, vol. iii. pl. v. fig. 2,) the yellow Sand, thrown down by the Dyke, is coloured as Magnesian Limestone, which is a mistake, the Limestone existing only in thin beds, subordinate to the Sand, which is here of great thickness.

at Cullercoats, a bed of Shale, having a hade or dip, at a considerable angle, towards the north. On the southern side of the quarry, in several places where the stone has been worked near the line of the Dyke, marks of mechanical action are visible, particularly near the Rail-way, on its eastern side.

The general opinion is, that this patch of Limestone overlies both edges of the Dyke, and that it has been deposited not only after the slip took place, but after the removal of the whole of the high side, which would necessarily be left, by the sinking down of the strata on the North. This is an opinion from which I confess I differ with reluctance; nevertheless, as the Limestone at Cullercoats is manifestly thrown down along with the yellow Sand, and contorted by mechanical action, we are compelled to come to the conclusion that the 90-fathom Dyke was formed after the deposition and consolidation of the Magnesian Limestone; and this would necessarily be our conclusion if there were no marks in the quarry at Whitley to point it out, as we cannot suppose the Limestones in the two situations to be of different ages, or, closely connected as they are, to be operated upon by different causes.

The idea of the Limestone overlying the Dyke, may possibly have arisen from its being considered as a perpendicular fissure, which it certainly is not, either in the quarry at Whitley, at Cullercoats, or at Gosforth, where it has lately been so completely examined in Mr. Brandling's new colliery.

We have thus traced the edge of this formation through the whole of the county of Durham, and to Cullercoats, in Northumberland, its most northern limit, and, in the whole line, we have seen the yellow Sand and Red Sandstone accompanying the Magnesian Limestone; the series of specimens now before the Society, from the different localities, will show most of the characters of the two beds. At the same time it must be admitted, that hand specimens can give but a vague idea of a formation of such extent and variety as this is. In many situations on the line it might be taken by any one, who had not examined it thoroughly, to be a Sandstone of the Coal Measures, but a more extensive survey, with an attention to all the circumstances under which it occurs, could not fail of satisfactorily pointing out its true relations to the adjoining strata.

The most convincing proof of its total independence of, and want of conformity to, the Coal Measures, is the difference of depth at which the same seam of Coal is found along the line of its outcrop. If we take, for instance, the Low Main Coal of the Tyne, which is the Hutton Seam in the collieries on the Wear, we shall find its depth below the Red Sandstone, as follows:—

	Fathoms.
At the foot of the cliff below Tynemouth Castle it will be about	75*
At Laygate Quarry about.....	140
At Clacksheugh, at least	230
At Houghton-le-Spring (Lord Durham's new pit), ...	132
At Moorsley (Mr. Russell's pit),.....	95

To the south of Moorsley, the seams of Coal unfortunately again change their names, and it would, therefore, be impossible, without further investigation, to trace the continuity of each individual seam, but, it may be stated, that the Sandstone crosses the Coal strata, at many various depths, above a Coal in that district, called the Five-Quarter Seam, and, in its range southward, very nearly comes in contact with the Grit and Shale beds below the whole of the Coal series.

	Fathoms.
At Quarrington Pit from the Red Sandstone to the Five-Quarter Seam, is	37
At Eldon Pit from the Red Sandstone to the Five-Quarter Seam, is	9
And at Cowndon Pit from the Red Sandstone to the Five-Quarter Seam, is	57

The source of the Brine Springs, which are found in several situations in this neighbourhood, has long been a matter of interesting speculation. As it has now been ascertained that we have below the Magnesian Limestone, a formation of new Red Sandstone, may we not be allowed to conjecture that a bed of Rock Salt is existing in it somewhere, as this stratum is well known to be the great depositary of that substance all over the world? This idea is rendered more probable by the situation of the places where salt Springs occur, none of which are at a great

* This estimate is made upon the idea of the seam of Coal seen immediately beneath the Two-gun Battery, at the south end of Cullercoats Sands, being the High Main; but, as there is reason to believe, from the very best authority (Mr. Buddle), that it is either the Bensham, or Yard Coal, it is probable the Low Main Coal is much nearer the Red Sandstone than above stated.

distance from the outcrop of this stratum. Butterby, near Croxdale, is about two miles from it; Lumley is rather less than two miles; Old Walker Colliery is farthest from the line, being about three miles and a half; and Jarrow is the nearest, being little more than a mile and a half.*

The great scarcity of organic remains, in the lower beds of the Magnesian Limestone, is rather singular. In the foregoing Notice, four different localities have been mentioned, where Fish have occurred, all in the Slaty beds of the Limestone, a few feet above the yellow Sand. Organic remains are at all times of great use to the geologist and observer of nature; they are, as it were, nature's own medals of the wonderful changes that have taken place, upon the surface of the globe, before it was brought to its present state; and the great importance of these Fish is, the light they may throw upon the nature of the changes that have taken place at the time they were buried. That the catastrophe was sudden, the forms in which they occur, and their perfect preservation, sufficiently testify; indeed, it is a generally received opinion, that where the remains of soft bodied animals occur, with their outward form perfectly preserved, and associated in families, they have been suddenly overwhelmed, and entangled in the substance now forming their stony matrix. It is a singular circumstance attending these Fish, and one in which they agree with those that have been found in different situations upon the Continent, that many of them are contorted; not that sort of twisting which might be produced by any movement in the mass, and subsequent to the time they were enveloped, but the graceful contortions of the living animal in a state of pain, as if struggling against its fate.

* Besides the places above enumerated, Brine Springs are common in the collieries of Hebburn, Wallsend, and Percy Main.

Postcript to Mr. Hutton's Notes on the New Red Sandstone, of the County of Durham, below the Magnesian Limestone.

Read May 18, 1830.

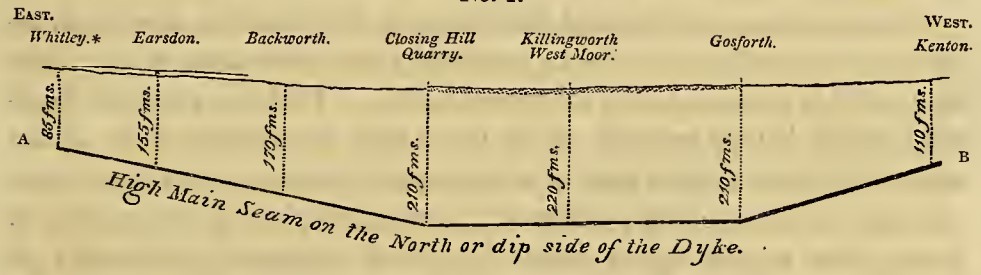
During the progress of the foregoing Notes through the press, we were induced to examine the effects upon the strata caused by the 90-fathom Dyke, at the point of its greatest depression, certain appearances having led us to suppose that the lower New Red Sandstone existed somewhere near Killingworth, and we found it accordingly in one spot, called the *Clowsden* or *Closing Hill Quarry*, situate about 950 yards to the south of Killingworth House, and immediately adjoining the Killingworth Railway. It is of inconsiderable extent, and forms a small hill, which slopes gently on every side, except where it has been broken in upon for quarrying the stone. There are two quarries, that on the northern slope of the hill has been extensively worked; it is now full of water, but is said to be 60 feet deep. The southern quarry was drained by means of a drift, from the bottom of the hill; this was driven northward entirely in Sand, until the face of the rock was suddenly and abruptly come upon, which was no doubt the northern cheek of the Dyke. I am informed by my friend, Mr. Nicholas Wood, that a seam of Coal 20 inches thick, with a Shale bed above it, appeared in the north quarry; this Coal stratum is higher than any bed we have been hitherto acquainted with in this Coal field. The highest known is in Hebburn, Jarrow, and South Shields collieries, from their pits being sunk at the point of the greatest depression of the strata, or at the bottom of the Coal Basin, as it is termed; it is 114 fathoms above the High Main, whilst this is 190 fathoms at least.

The Red Sandstone exhibits here its usual characters, but the Ruddle is in greater abundance than common, particularly in the lower part of the bed, where it exists in large masses, all the farmers in the neighbourhood supplying themselves from this quarry with Keel (as it is termed, and the spot the Keel Quarry), for marking their sheep. Its

dip is 15° south, whilst the dip of the Coal Measures is twice this amount, or about 30°. It is satisfactory to know, that this has been proved by the working of the High Main Seam below, because it would appear that the dip of the Coal seam and Shale bed which were found in the quarry did not differ much from that of the Red Sandstone; nevertheless, I am perfectly borne out by the personal observation and practical experience of Mr. Wood, in considering the Red Sandstone here "in general position clearly unconformable with the Coal Measures."

The relative position of this patch of Red Sandstone will be best understood by a reference to the annexed diagrams. In the sketch, No. 1. the line A B. represents the course of the High Main Coal Seam, on the north, or low side of the Dyke, having the depth marked at which the Coal has either been worked, or proved to exist, at seven different points; and shews the remarkably undulating line each bed takes, by the unequal depression of portions of the strata. I have taken the High Main Coal, as the representative of the whole series, from its being best known, but the continuous line exhibited, although sufficient for our present purpose, is incorrect, as many slips or dykes occur, throwing it down in portions unequally.

No. 1.



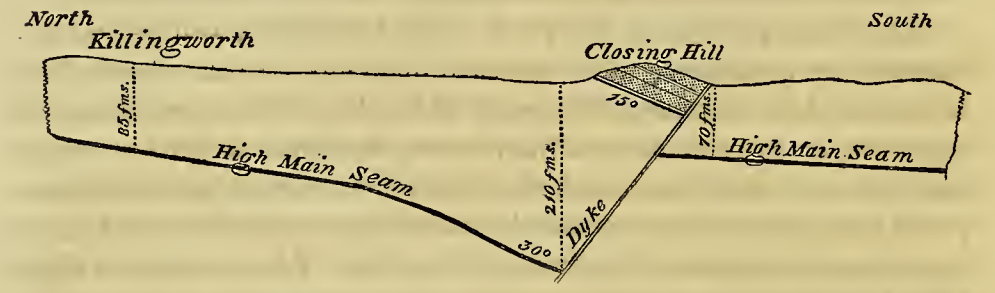
The amount of "throw" caused by the Dyke at the points named in the diagram No. 1, will be nearly as below:—

At Whitley.	Earsdon.	Backworth.	Under Closing Hill Quarry.	Killingworth West Moor.	Gosforth.	Kenton.
100 *faths.*	150 *faths.*	160 *faths.*	140 *faths.*	175 *faths.*	170 *faths.*	120 *faths.*

* The depth at which the High Main Coal is worked in Whitley Colliery, on the north of the Dyke, is, by mistake, stated to be 50 fathoms, in the 4th vol. of *Geological Transactions*, page 25.

The diagram, No. 2. represents an ideal section of the strata from Killingworth Village southward, through the Closing Hill Quarry. It is a remarkable circumstance that, although the slip, or "throw," is here so enormous, yet, that the derangement, arising from the increase of inclination of the strata, extends but a very short distance from the Dyke.

No. 2.



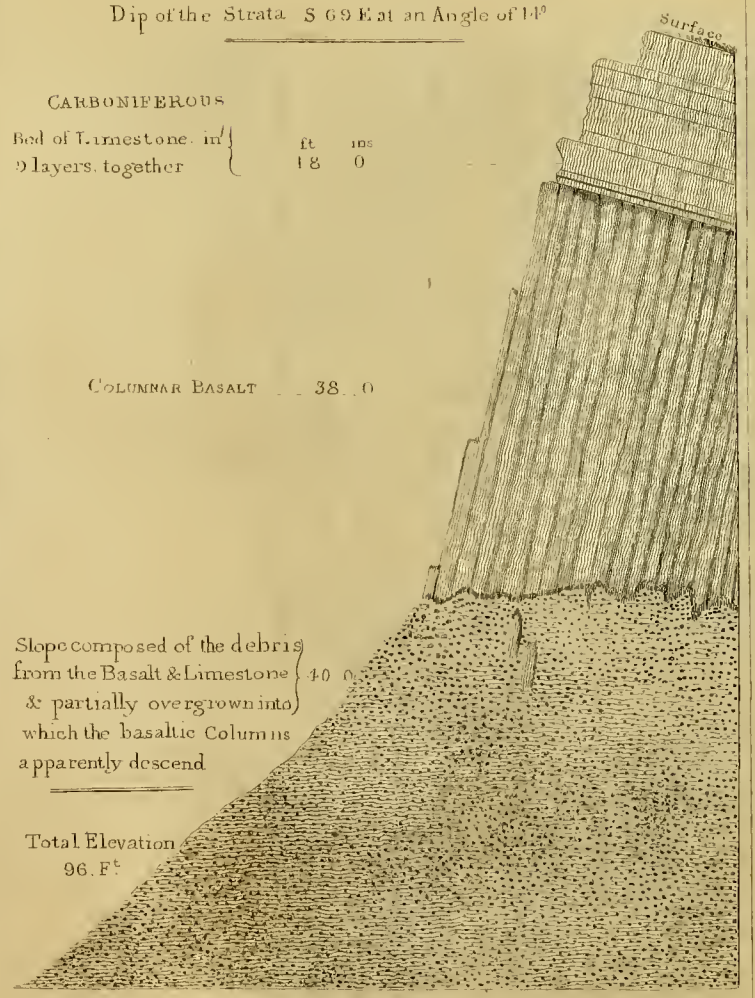
Killingworth House which is, as before stated, about 950 yards north of the Dyke, is built upon the Grindstone Post, a well-known Sandstone bed here at the surface; but, if we wished to find that bed at the Dyke, we should have to sink 120 fathoms before we reached it.

The occurrence of the Red Sandstone, in the situation described, affords evidence of great value in estimating the correctness of the views taken of this stratum in the foregoing notice. That this patch of Sandstone which is now upwards of six miles from the nearest point of the same rock, once formed part of a continuous stratum, we cannot doubt, nor that the intervening portion has been removed by the operation of water, that mighty agent which has been employed universally in modifying the surface of the globe. It is difficult to obtain an idea of the extent of force necessary, but it is, nevertheless, as probable, that such a removal of this bed may have taken place, as that the strata on the high side of the Dyke have been removed, which, when the slip took place, must have presented, at this point, a face of rock, upwards of 1000 feet high.

PLATE. X.

SECTION OF RATCHEUGH CRAG

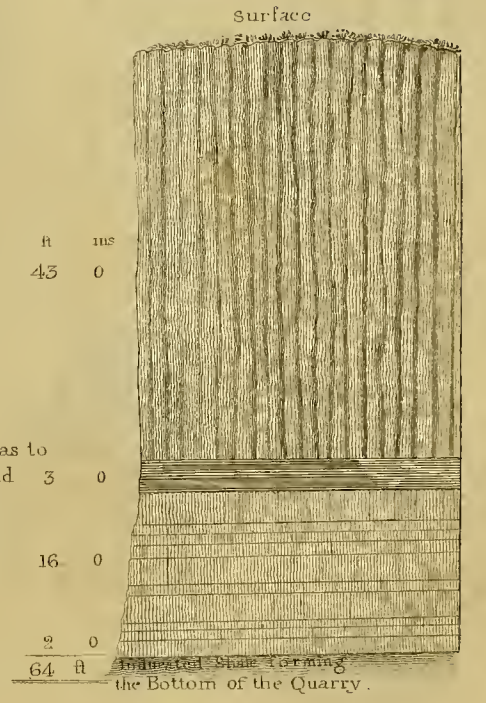
Dip of the Strata S 69 E at an Angle of 14°



SECTION OF SNABLEASES QUARRY

Taken in the direction of the Waterlevel Line

Dip of Strata S E at an Angle of 17°



	ft	ins
Columnar Basalt	43	0
Shale altered & indurated so as to resemble porcelain Jasper and containing Orthoceratites	3	0
Carboniferous Limestone	16	0
Compact Basalt	2	0
	64	ft

Indurated Shale forming the Bottom of the Quarry.

Scale 20 Feet to an Inch

Drawn by Fra^s Forster

Etched by M Lambert

No. XII.—*Observations on the Geology of Ratcheugh Crag, near Alnwick. By* Mr. Francis Forster, *Colliery Viewer.*

Read May 18, 1830.

In offering to the Notice of the Natural History Society the following observations on the geology of Ratcheugh Crag, I have to regret that want of time prevented me from examining the course of the Basaltic Rock, of which it is chiefly composed, beyond the immediate neighbourhood. The limited observations, however, which I was enabled to make, have very strongly impressed me with the idea, that the Basalt of Ratcheugh Crag is a continuation of the same bed which forms the Dunstanborough Castle Cliff, as well as the bold escarpment extending southward behind Craster Sea Houses. I have been induced to form this opinion by the conformity in the inclination of the strata on the coast and at Ratcheugh, by the surface of the country, which appears to rise from the sea at the same angle and in the same direction as the strata, and by the similarity in the strong Limestone bed with which the Basalt is, in both cases, accompanied.

Ratcheugh Crag is situated at about two miles and a half E. N. E. from Alnwick, and at about the same distance west, from the sea, at Boulmer. It forms a cliff, facing to the west, and rising about ninety feet above the level of the country, extending towards Alnwick. A tower, built on its summit, commands a most extensive prospect over the surrounding district. Before referring to the section of the Crag itself, which evidently owes its peculiar structure to a Dyke in the vicinity, it will be necessary to subjoin the following section of the strata sunk through at Dunsheugh Coal pit, situated at about four hundred yards to the S. E. of the Crag, and set off from the surface in the Limestone, underlying the Basalt, and at about two hundred yards beyond

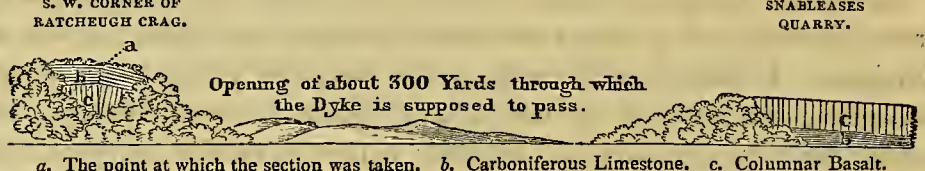
the basset of the latter. This pit is in a situation where the strata may be considered in their regular position.

SECTION AT DUNSHEUGH PIT.

	Feet.	*In.*
Bed of carboniferous Limestone (cropping out from under the Basalt, with a few feet of intervening Shale) about	15	0
Coal, varying from 4 to 8 inches, say	0	6
Shale,	33	0
Sandstone,	15	0
Bed of Shale, containing an abundance of bivalve shells (Producta castata),	0	6
Bituminous Shale (variable),	3	0
Coal (divided by a 10-inch band of bituminous Shale), varying from 1 foot 8 inches to	2	0
Total,	69	0

(Or $11\frac{1}{2}$ fathoms.)

At a very short distance to the west of this pit may be seen evident traces of a Basaltic Dyke. It is to this Dyke, which will intersect Ratcheugh Crag, nearly at a right angle with its range, causing a breach of about three hundred yards in width, that I attribute the remarkable difference exhibited in the sections of Ratcheugh Crag and Snableases Quarry. The following rough sketch will convey a sufficiently accurate idea of the relative situations of these two points.



a. The point at which the section was taken. *b.* Carboniferous Limestone. *c.* Columnar Basalt.

It presents a view of the face of the Cliff to the westward; Snableases Quarry being situated a little further to the dip than Ratcheugh Crag, and, from its range, partially representing the dip of the strata; whereas the face of Ratcheugh Crag ranges nearly in the drift, or water level course of the strata.

The section of the strata of which Ratcheugh Crag is composed (*see*

Pl. X. Fig. 1), is taken, not in the face of the Cliff, but in the dip and rise direction, at the angle formed by the breach—at *a* (*see* the rough sketch). I selected this point with a view of displaying more clearly the position of the Basaltic columns, and the overlying bed of Limestone. On examining the section, it will be observed that the columns of Basalt, instead of being perpendicular to the horizon, stand at a right angle with the plane of the inclination of the strata, and that the same appearance is exhibited by the "backs," or partings, cutting through the bed of Limestone above it. May it not be inferred from this, that the present inclined position both of the Basalt and Limestone has been assumed *after* their deposition and consolidation? The bed of Limestone forming the top of the Cliff is divided into nine different layers, none of which appear to have been affected by the vicinity of the Basalt, except the lowest. This layer is 10 inches thick; divided from the layer above it by a Shale bed of 3 inches; but, having its lower facing in immediate contact with the top of the Basaltic columns. For 4 or 5 inches above the junction the colour of the Limestone is changed from dark-grey to brown, and its texture is more compact and crystalline; this appearance gradually fades in passing upwards, and, at a distance of 6 or 7 inches from the junction, the Limestone assumes its usual characters. In point of position, inclination, &c. the Limestone and Basalt are perfectly conformable to each other, dipping at an angle of 14° in the direction of S. 69° E.

On comparing the above-described section with that at Snableases Quarry (*see* Pl. X. Fig. 2), a remarkable change in the relative position of the strata will be observed; here, the Limestone, instead of reposing upon 60 or 80 feet of columnar Basalt, is underlaid by 2 feet of that rock, in a compact mass, and overlaid, first, by a stratum of Shale, changed in its appearance so as to resemble porcelain Jasper, and then by a columnar Basaltic bed of 43 feet in thickness. In external appearance the Limestone appears little, if at all, altered by the vicinity of the Basalt, although the lower, or 2-feet, bed of the latter is in actual contact with it. This 2-feet bed is considered as usurping the place of the thin seam of Coal (which at Dunsheugh Pit, and elsewhere, is found to underlie

the Limestone); an idea which is strengthened by the stratum immediately under the Basalt presenting the appearance of a Coal thill. In this quarry, as at Ratcheugh Crag, the Limestone, Shale, and Basalt are, in point of inclination, perfectly comformable to each other; dipping to the S. E. at an angle of 17°.

The Dyke, which I have considered as cutting across the Cliff, and producing the remarkable difference in the sections, is, I think, an upcast to the N. E. Ratcheugh Crag will, therefore, be on its *rise*, and Snableases Quarry on its *dip* side. That the Basalt overlying the Limestone in Snableases Quarry, does not appear above it in Ratcheugh Crag, may be owing to the elevation on that side, and the great thickness of the Basalt *under* the Limestone in Ratcheugh Crag may, perhaps, be attributed to the same cause. To this Dyke, indeed, I should have considered that the whole of the Basalt in the vicinity owed its origin (conceiving it to be an overlying mass similar to that at Bolam, in the County of Durham), but for the reasons already mentioned in favour of its being a continuation of the Dunstanborough range, and the additional evidence of its extent, afforded by the existence of a considerable tract of Basalt, about three-quarters of a mile to the N. W., capping an eminence called Harlow Hill, and appearing to conform, in range and direction, to the bed at Ratcheugh; thus exhibiting a much more extensive formation than our present knowledge of them would warrant us in attributing to Basaltic Dykes. As they are phenomena, however, concerning which much is probably yet to be learnt, I do not by any means presume to propose limits to their operations, and the principal object of the above observations is to put the Society in possession of the *facts*, leaving the *causes* of the appearances, I have endeavoured to describe, for abler and more extended investigation.

Newcastle, May 17, 1830.

No. XIII.—*On the Discovery of a Number of Hazel Nuts, in working a Lead Ore Vein in the Manor of Alston Moor.* *By* Mr. H. L. Pattinson.

Read May 18, 1830.

On Thursday, April 15th, 1830, the workmen in Nattrass North Vein Lead Mine met with about thirty Hazel Nuts, while driving a gallery, or drift, for the purpose of obtaining Lead Ore. A report of this circumstance having immediately got into circulation in the town and neighbourhood of Alston, in which it was stated that a number of Nuts had been found in a Lead Ore Vein, the writer of this notice was induced to examine the matter personally, and presents to the Society the following account of it, as much to prevent erroneous impressions and conclusions, as from any intrinsic interest connected with an occurrence apparently of so singular a nature.

Nattrass North Vein is situated about a mile and a half south east of the town of Alston, and has been worked extensively in the stratum, No. 153 of Forster's *Section*, called the Great Limestone, and in the Sandstone strata above it, to the high Slate hill, No. 129. The workings in the Limestone were formerly prosecuted by a level in the Shale bed on the top of the Great Limestone, and the Ore was worked out of the Limestone by means of sumps below the level sole, or floor. Within the last two years, a lower level has been driven up to the vein by the present company in a Shale bed below the stratum called the Tuft, which immediately underlies the Great Limestone, and the Ore is now obtained by means of "rises" into the Limestone, out of this level. Nattrass Vein bears within a few degrees of east and west, throws down the north cheek two feet, and in the Great Limestone is from 18 inches to two feet wide, which space is filled up with Vein Stone, or Rider, and

Lead Ore, in greater or less proportion, with, towards the bottom of the stratum, a considerable intermixture of Clay.

At the distance of eight fathoms on the north side of Nattrass North Vein, and running nearly parallel with it, is another weak vein which, as very weak veins are locally called "strings," is called Nattrass North String. This small vein is from 4 to 8 inches wide, has a throw down to the south of about two inches, and contains several small ribs of Lead Ore, from half an inch to an inch, or, occasionally, two inches in thickness. These ribs of Ore stand upright, and there are generally two or three in the width of the vein, perfectly detached from each other and from the sides, the spaces between being filled up with a sandy Clay, occasionally coloured orange, or red, by Oxide of Iron.

In order to obtain the Ore out of this small "string" a drift' or gallery, is driven in the vein, through a certain length of ground, generally about 15 fathoms at the bottom of the Limestone, after which the remainder of the Ore, to the top of the Limestone stratum, is worked out by what the miners term headings.

In driving a drift of this kind, at the bottom of the Limestone in this string, the miners opened into a joint, or cavity, two feet wide, and four feet high, containing, at the bottom, a stratum of Clay and filled above, with small water-worn gravel, in the midst of which the Hazel Nuts, forming the subject of this paper, were discovered. The cavity, or joint, existed on both sides of the vein, a portion of the Limestone, forming its natural sides, or cheeks, having been removed on each side, and the space filled up to a certain extent by clay, and by water-worn gravel above; but two or three small ribs of Lead Ore, about three-quarters of an inch wide each, existed through both the Gravel and Clay, exactly in the same way as further up, where the Ore was confined by the solid cheeks of Limestone on each side.

The Nuts were not lying in the same level with respect to each other, but were indiscriminately mixed up with the Gravel, and diffused through a mass of something less than a cubic foot, and among them was also a small twig, or branch of a tree; but this was not preserved by the miners, being, as might be expected, in a very decayed state.

From these circumstances it seems evident, that the Nuts have been washed into the cavity by a current of water, and, it is probable at no very remote period. They might have been thrown down by accident on the surface, in a situation to be carried by a stream through a fissure into the Limestone stratum.

It is probable also, that the cavity itself has been formed in the Limestone long after the formation of the vein and deposition of the ribs of Lead Ore, although it is difficult to conceive that the small ribs of Ore could have stood perpendicularly when deprived of the support afforded them by the solid cheeks of the vein.

That Limestone strata are acted upon and dissolved by water, in the interior of the earth, there can be no doubt, and, that the sides of veins, when of Limestone, are sometimes removed by solvents, having no action on their metallic contents, is equally certain. The writer of this paper observed a fact in Galligill Syke North Vein, about three years ago, strikingly corroborative of this idea. The vein contained a rib of solid Galena, six inches wide, between two sound Limestone cheeks, but, in its course, it traversed a water-worn cavity of some extent, and, in this situation, the rib of ore stood through the middle of the open space, without support on either side, shewing that the cheeks of the vein must have been removed after the rib of Ore was formed in that position.

Lowbyer, Alston, April 20, 1830.

No. XIV.—*Observations on the South Welsh Coal Basin.* *By* Mr. Francis Forster, *Colliery Viewer.*

Read June 15, 1830.

Conceiving it to be one of the objects of the Natural History Society, to collect information from every source, relative to the various Coal districts of Great Britain, I have been induced to lay before them the following observations, accompanied by a section across the Mineral Basin of South Wales, collected from a variety of surveys, from personal observation, and from actual borings and sinkings, made under my direction, during several years' residence in Carmarthenshire.

The South Welsh Coal-field, independent of its geological interest, (arising from its great extent, its perfect formation as a *Coal Basin,* and the remarkable variation in the quality of its numerous seams of Coal,) cannot, I think, fail to be generally interesting, when considered as the district in which nearly one-half of the immense supply of British Iron is raised, smelted, and manufactured; as the source from which the Cornish mines not only derive their supply of Coal, but by which the whole of their produce is reduced to the metallic state; and lastly, as the market to which the Metropolis must turn for a supply, whenever the distant period arrives that the Coal of our northern districts either becomes so scarce, or so difficult and expensive to procure, that its pre-eminent footing in the London market can no longer be maintained.

Before proceeding to a general description of this district, it may, perhaps, be interesting, briefly to allude to the various papers already published concerning it. At so early a period as the year 1570, an Essay on the relative position of the strata forming this mineral basin was written by Mr. Owen, of Henllys, in Pembrokeshire. An epitome of

SECTION FROM NORTH TO SOUTH ACROSS THE
SOUTH WELSH MINERAL BASIN
From the North Basset of the Limestone on Mynydd Mawr in Carmarthenshire
to its South Crop near Ilston in the County of Glamorgan
by
Francis Forster — Colliery Viewer
Dip S12W 12°
Old red Sandstone
Carboniferous Limestone
Millstone Grit or "Farewell Rock"
Mynydd Bach
Division No 1. General Bearing S6°E. Length 5 miles 700 yds or 4750 fathoms.
North
Cornhwll 600 yds
Penprys Seam
Clingwernen Seam 4 feet
Culm
CENTRE of the BASIN
Carnarvon Engine Pit
Llwchwr River at High Water
Division No 2 General Bearing S10°W Length 5¾ miles or 5060 fathoms
Scale 2¼ inches to a mile or 352 fathoms to an Inch
Total Length of the Section 15 miles 260 yds, or 13 330 fathoms
Reference
The Bearings are all calculated from the Magnetic Meridian of 1827
Slaughter pit Seam
Hendy Seam
Big Seam 5 feet
Brass Seam 4 feet
Froghole
Mynydd bach
Thirteen Small Seams in this space
Principal beds of Iron-Stone supposed to crop out in this Space
Old red Sandstone Supposed to lie flatter & afterwards DIP to the South
Division No 3
Bearing S40W being in the direction of full rise from the Dunraven Pit Length 4 miles or 3520 fms
Mem. All the Seams in this division are bituminous

this paper has been given by Messrs. Buckland and Conybeare, in their Observations on the south-western Coal Dictricts of England, published in the 1st vol. of the *Geological Transactions*, second series; and considering the great interest attached to Owen's paper, as being the earliest known atttempt to trace through an extensive district the connection and continuity of different strata, I cannot, perhaps, do better than copy verbatim Messrs. Buckland and Conybeare's observations concerning it.

"The earliest document in which any material information, bearing on the south-western Coal district, is to be found, is an Essay on the *History of Pembrokeshire*, left in manuscript, Anno 1570, by George Owen, of Henllys, in that county, but not published until the year 1796, when it appeared in the *Cambrian Register*. This Essay of Owen is a work of the highest interest, as being the earliest example extant, in any language, of what can properly be called geological investigation. About a century before this period, indeed, the attention of several Italian writers had been directed to the organic remains of the Sub-Appenine districts, which lie scattered in such quantity and preservation as not to have escaped the notice of the poets of classical antiquity. It was the single fact, however, of the occurrence of marine remains in inland situations that those writers observed; and with the single exception of George Agricola, who about the year 1550, in his Treatise *de Re Metallicâ*, described the more obvious phenomena of metallic veins, no writer until the time of Owen appears to have studied the nature and position of the mineral masses which constitute the crust of the globe.

"Owen describes the extent and general features of the mountain chains of Pembrokeshire, and the course of the rivers to which they give rise, with an accuracy and spirit which it would be difficult to equal. But, what chiefly distinguishes his memoir is, the observation that the mineral masses, constituting the earth's surface, are not thrown together promiscuously, but are arranged in a regular order, and in continuous lines over extensive districts; an observation which forms the great basis of all scientific geological investigation. Owen verifies this

observation by tracing two bands of Limestone with the Coal adjacent to each, along the northern and southern frontiers of the Pembrokeshire Coal-field; and that, not only through Pembrokeshire, but in continuation through the other counties of South Wales; that is to say, over a tract exceeding 100 miles in length. He thus anticipates much of the information contained in the valuable Memoir on the Coal Basin of South Wales, communicated by Mr. Martin, to the Royal Society, in 1806.

"The connection of these calcareous bands with those of the Forest of Dean and neighbourhood of Bristol, is likewise suggested. A third line is also traced to the north of the northern calcareous band in Pembrokeshire, along which Owen supposes another continuous band of Limestone to extend. Along this line, however, the calcareous masses, which occur, are discontinuous, and are in truth detached portions of transition Limestone, subordinate to Greywacke Slate, which, very generally along that line, contains a mixture of calcareous matter.

"At the same time that Owen lays down correctly the general fact of the regular arrangement and continuity of mineral masses, he appears to have had confused notions of their position below the surface of the earth. He calls these masses, indiscriminately, *veins*, is ignorant of the distinction between veins and beds; neglects entirely the dip of the beds, and seems not to have entertained any suspicion that the two bands of Limestone, the northern and the southern, had a subterraneous communication, and thus formed a great Basin, containing the superincumbent Coal Measures; a doctrine afterwards so ably developed in the paper of Mr. Martin. We do not find in Owen's Memoir any notice of the organic remains of the strata."

The idea entertained by Owen that the mineral masses he describes were separate veins or bands, passing downwards to an indefinite depth, though apparently absurd to those accustomed to the comparatively level and regular strata of our northern districts, was by no means unnatural in Pembrokeshire, where the beds of Coal and Limestone are highly inclined and contorted, and at a period when the imperfect state of machinery rendered any research below the mere outcrop of the

seams impracticable. It is not, indeed, uncommon to find miners among the Welsh collieries, generally speaking a very intelligent race of men, who have not yet become converts to Mr. Martin's idea of a mineral *Basin:* to the same cause may probably be attributed the term *gwythyen*, or *vein*, universally given by the Welsh miners to a seam or bed of Coal.

To the late Mr. Martin's valuable paper we are, I believe, indebted for the first idea of a Coal Basin, or trough of Coal Measures, reposing upon a distinct, continuous, and underlying mass of carboniferous Limestone; a formation which, however indefinite in the Northumberland and Durham Coal districts, is most clearly developed in the South Welsh Coal-field. Of the boundaries of this Basin, Mr. Martin has also given a sketch, together with a perpendicular section, apparently taken in the vicinity of Merthyr; these are accompanied by a variety of observations reflecting the highest credit upon the ingenuity and research of the author, and such, in fact, as might have been expected from a mineral surveyor of such extensive practice and high character.

Mr. De la Beche, in the 2d. vol. of the *Geological Transactions*, 2d. series, has published a highly interesting account of the geology of Southern Pembrokeshire, accompanied by a map and sections, in which he includes that part of the great Coal Basin extending across the county of Pembroke. As the apparent object of this paper is to point out the geological relations of the different rocks ranging through the district, composed of Trap, Greywacke, Old Red Sandstone, carboniferous Limestone, and the Coal Measures, the author necessarily makes the quality, &c. of the Coal beds themselves, a matter of subordinate consideration. The effects produced by the Trap rocks, occasionally interposed between the different members of this part of the Coal-field, as described by Mr. De la Beche, bear a striking resemblance to the undulations and contortions of the strata, along the N. E. coast of Northumberland, and which may probably be attributed to the same disturbing cause.

Messrs. Buckland and Conybeare, in the paper already quoted, have illustrated in a most lucid manner, the Coal Basins of Bristol

and the Forest of Dean, but their remarks on the South Welsh Coal-field do not extend beyond the observations necessary to establish its connection, as resting on the same general basis of Old Red Sandstone, with the former districts; and a variety of remarks, accompanied by a section from Brecon to the Bristol Channel, pointing out, in a most striking manner, the relative positions of the Old Red Sandstone, Limestone, and Coal Measures, and of the unconformable and overlying masses of Magnesian Limestone, New Red Sandstone, and Lias, in the vale of Ely, near the eastern termination of the Basin.

The observations I am about to offer, are of a more practical nature, have a different object, and principally refer to a different part of the Coal-field from all these, otherwise I should not have ventured upon a subject which has passed through such able hands. I shall, after attempting to convey a general idea of the extent and position of the beds forming this Basin, confine my remarks to the nature and quality of its various seams of Coal, and to a description of the strata in those particular portions of the counties of Carmarthen and Glamorgan, across which my line of section passes.

RANGE AND EXTENT OF THE WELSH BASIN.

On referring to Greenough's *Geological Map*, it will be observed, that this Coal-field extends in an east and west direction in the form (to use a familiar simile) of a long-necked flask, from Pontypool in Monmouthshire, to the Irish Channel on the coast of Pembroke; the western end or neck (about 2½ miles in width) commences at St. Bride's Bay, and extends across that county to the eastward about 28 miles, where it is cut off, at Pendine on its northern, and at Tenby on its southern edge, by that part of the Bristol Channel forming Carmarthen Bay; its width at the point where it is thus intersected having increased to about 6 miles. The Coal Measures continue their range to the eastward across this Bay, and on again entering the land forming its N. E. side, their width from north to south is about 10 miles. About 10 miles to the eastward, and at a point which may be termed the shoulder of the flask, in width about fifteen miles, the section

accompanying these observations was taken. The south edge of the Coal Measures now range across the promontory of Gower until they are again encroached upon by the sea in the form of a crescent, forming the fine Bay of Swansea. About half way across this promontory, the Old Red Sandstone becomes covered and concealed by the overlying bed of Carboniferous Limestone, changing its dip to the southward.* Up to this point, about 47 miles from the western end of the Coal-field, the Carboniferous Limestone and Old Red Sandstone, forming the basis on which the Coal Measures repose, basset, or crop out, along both edges of the Basin, except in a portion of Pembrokeshire, extending to the north-west of Milford Haven, where they rest on Trap and Greywacke for about 10 miles on their south basset, and on Greywacke for about 5 miles on their north basset. (*See* the Plan and Sections by Mr. De la Beche already referred to.) After an interval of 12 miles, occupied by Swansea Bay, the southern edges of the Coal Measures again enter the Land near Margam, and their total width from north to south has increased to 20 miles, about the greatest width they attain. At this point, *the highly inclined basset edges* of the Limestone and Old Red Sandstone become partially covered over and concealed, by an *overlying and nearly horizontal* deposit of Magnesian Limestone and Lias; this continues for about nineteen miles to the eastward, where the Limestone and Old Red Sandstone finally emerge to the day from under the newer formations, near the village of Pentirch, and continue to maintain an elevation round the eastern termination of the Basin, which the newer Rocks never reach; near Pontypool the Basin terminates in a semi-circular sweep, extending from north to south; its width at its termination is about 12 miles. The total length from Pontypool to St. Bride's Bay, is 93 miles, and the area within the Limestone, exclusive of the portions cut off by Swansea and Carmarthen Bays, or in other words, the available portion of this Coal district is

* This change in the dip of the Limestone, from north to south, prevails to such an extent along the south edge of the Coal-field, that the existence of another trough of Coal Measures, in the Bristol Channel, is by no means improbable.

about 935 square miles. This extensive field is distributed among the five counties through which it ranges, as follows, viz. :

	Miles.
Pembrokeshire,	80
Carmarthenshire,	133
Brecknockshire,	68
Glamorganshire,	569
Monmouthshire,	85
Total	935 Sq. Miles.

THE GENERAL DIP OR INCLINATION OF THE STRATA

In this district will be best understood by an examination of the section (Pl. XI.). It may, however, be remarked here, that the strata, cropping out on the north or inland side, *dip*, with occasional undulations, *to the southward*, across about three-fifths of its width, when the direction of their *dip is reversed, and they rise to the southward*, through the remaining two-fifths of the width of the Basin ; hence the greater inclination of the beds on the south, than on the north side of the trough.* The angle of inclination varies from 5° to 46°, or from 6 inches to 6 feet per fathom, being through its whole extent greatest near the edges, and least near the centre of the Coal-field ; and, as regards its different parts, the strata are much flatter in the wider or eastern portion of the Basin, than in the western, or more contracted part. Near its eastern extremity, indeed, the dip is altered, the strata rising gently in that direction, and but for the occurrence of a number of Dykes, traversing the district from north to south, and generally throwing the strata down to the eastward, it is probable that their extent would have been much less considerable. It is, in all likelihood, from the same cause that the bottom of the Basin in Pembrokeshire, on the west or upcast side of these Dykes, approaches so near the surface. Here, according to Mr. Martin, the thickness of

* The whole of the Coal strata in Pembrokeshire, as well as the underlying mass of Limestone, are so much contorted (apparently by their contiguity to the Trap and Transition rocks) as to form, in some degree, an exception to the general inclination here given.

the strata above the Limestone, does not exceed 100 fathoms, while he calculates their depth, in Carmarthenshire, to be 600 or 700. My observations have led me to conclude, that their depth, at this latter point, will considerably exceed that amount, and will in fact approach very nearly to 1000 fathoms.

The basis of Old Red Sandstone, on which this Coal-field reposes, rises in one part to the great elevation of 2862 feet, forming the bold mountains called the Beacons of Brecon. The Coal Measures themselves, along their northern or inland range, also attain a considerable elevation; Mynydd Mawr in Carmarthenshire, as will be seen by a reference to the section, is about 1000 feet in height, and Craig-ar-Avon, near Merthyr Tydville in Glamorganshire, is 1859 feet in height. The southern edge of the Basin is generally much less elevated, but Margam Downs, on the East side of Swansea Bay, are 1100 feet high. The whole of the district is intersected by deep vallies, extending across it from north to south, which, together with the elevation of the strata, afford unusual facilities for draining and working by level immense tracts of Coal and Iron Stone; advantages, from which the great Iron smelters of Wales are enabled to obtain their materials, at a rate unequalled for cheapness in other parts of the kingdom. The great north and south vallies intersecting this district are ten in number, viz.:

1st. and 2d. The Valleys formed by the Cliddy and St. Lawrence Rivers, which extending inland from Milford Haven, completely intersect the Pembrokeshire part of the district about its centre.

3d. The opening or breach formed by Carmarthen Bay.

4th. The Vale of the Llwchor River extending with its branches across the Basin, from Pembrey nearly to Llandibie on its northern edge, rising 150 feet in that distance, 100 feet of which takes place in the last three miles.

5th. The Vale of the River Tawe, extending inland from Swansea to the North Limestone Hills, at Hennoyadd, and accompanied by a canal nearly to that point.

6th. The Vale of Neath, through which flows the river of that name, extending from Neath to Dynas Rock, and accompanied by a canal to

within 2½ miles of the North Limestone. Two other Rivers, the Avon and the Ogmore, extend from the south edge nearly to the centre of the Basin.

7th. The Vale of the Taafe, extending inland from Cardiff, intersecting the south edge of the Basin, near the Great Garth Hill, and stretching across it to Dan-y-Graig; along this valley runs the Glamorganshire Canal, forming a communication between the great Iron works at and near Merthyr, and the sea at Cardiff.

8th. The River Romney, the boundary between the counties of Glamorgan and Monmouth.

9th and 10th. The Vallies formed by the Elwy and Sirhowy Rivers, which run in north and south lines, nearly parallel to each other, across the Monmouthshire part of the Basin; they are accompanied by canals and railways, connecting them with the River Uske.

Of these outlets the first five are navigable within the edge of the Coal Basin, as is also the River Avon. These principal rivers, together with their tributary streams (which generally run in the water-level line of the strata and often between two ranges of Freestone, in vallies excavated in the interposing Shale beds), so intersect this extensive and elevated district, as to render the seams of Coal to a considerable depth available by levels, and afford the additional advantages arising from a convenient access to the various ports by means of canals and railways.

QUALITY OF THE DIFFERENT VARIETIES OF WELSH COAL.

In point of quality the Coal seams of this extensive district, in their leading characters, embrace every variety, with the exception, perhaps, of Cannel Coal, known to occur, in what is termed the independent Coal formation; these varieties may, for distinction's sake, be divided into three distinct classes—it is necessary however to observe, that these different classes run by insensible degrees into each other.

1st. *Stone Coal, Anthracite, or Glance Coal,* technically, "*hard Coal*":—Under this head, I propose to include all the varieties, which, when heated with the exclusion of air, as in a coke heap or coke oven,

are not materially altered in texture, shape, or bulk, and *still preserve all the external characters of Coal.* Stone Coal is hard and brittle, breaking into sharp-edged fragments; colour, greyish black; lustre, splendent and semi-metallic; fracture, imperfectly conchoidal; cleavage, presenting large and highly-polished surfaces, generally perpendicular to the strata; gives, when struck, a ringing sound, so that a number of small pieces when thrown from the shovel sound like broken china. The specific gravity of this Coal is about 1·380. The constituent parts of an average specimen were

Carbon,	89
Volatile Matter,	8
Earthy Residuum, affording in combustion, whitish light Ashes,	3
	100

There is a variety which I have not had an opportunity of examining, that contains a much greater proportion of earthy matter. It is not, I believe, of frequent occurrence.

Although Iron Pyrites is seldom found in the Stone Coal seams, yet many of them appear to contain Sulphur disseminated in some form or other through the mass, which, though invisible to the eye, affords abundant evidence of its existence in combustion, by its suffocating smell, and the rapid decay of the fire-irons and other utensils with which it comes in contact. Many seams of Stone Coal are, however, free from any mixture of this pernicious ingredient. The practical uses of Stone Coal, from the peculiar proportion of its component parts, are very limited. It is difficult to ignite and slow in combustion, but affords a strong and steady heat, emitting neither smoke nor flame, except, indeed, a thin yellowish-blue or green flame, similar to that given out by Coke in combustion. Considerable quantities are, however, exported for drying Malt; and, from its important property of burning without smoke, it has been partially adopted in London by brewers and distillers, and for the use of steam-engines, being first mixed with different proportions of Newcastle Coal.

Owing to the extensive range of the Stone Coal seams through this Mineral Basin, in close connection with its rich and abundant beds of

Iron Stone, traversing the most elevated, and, therefore, most available parts of the district, it has become a great desideratum, (perhaps the very greatest in connection with that department of our manufacturing interests depending on Mineral produce,) to adopt Stone Coal as a substitute for Coke in the smelting of Iron Ore, and various spirited attempts have, from time to time, been made to effect this desirable object, hitherto without success. This has been considered the more surprising, because the closest and most ponderous Coke having always been found best adapted for Iron-smelting, and Stone Coal being nothing more than a hard, compact, and ponderous mineral Carbon—it was naturally expected, that it would be, above all others, best calculated for the smelting of Iron Ore. Not having myself witnessed any of these practical experiments, I do not feel competent to give an opinion, as to the probability of their ultimate success; but from an attentive observance of the qualities of Stone Coal in ordinary combustion, I have become thoroughly convinced of the correctness of an observation made some time ago, by one of the most intelligent gentlemen in South Wales, that the *incapacity of Stone Coal, as a conductor of heat*, presents a *mechanical obstruction* which will be extremely difficult to overcome in its application to Iron-smelting. This imperfect conducting, or perhaps more properly speaking, transmitting power, doubtless arises from its want of bitumen, and the compactness and density of the Coal; and hence, when Stone Coal is substituted for Coke, in the furnace, the application of the blast, instead of causing ignition to extend through very part of the fuel intermixed with the ores, will, if urged to the necessary degree, absolutely blow out the fire. That this difficulty will be eventually overcome, perhaps, admits of little doubt; but the adoption of Stone Coal in Iron-smelting will, in all probability, be effected, by substituting some other flux in the furnace instead of Limestone, by which the Iron may be separated from its earthy ingredients, at such a temperature as may be obtained in an air furnace, without the assistance of a blast.

Stone Coal Culm is chiefly derived from the small, produced in working the Coal, and which, when the texture of the Coal is good, bears a

very small proportion to the total quantity worked, but not possessing the property of breaking into cubical pieces, like Newcastle Coal, this small, in the process of working, is generally reduced to powder. The Stone Coal seams, without sustaining any other material alteration in quality, not unfrequently become so soft and tender, for many acres together, as to be fit only for *Culm*. *Stone Coal Culm*, from its slow combustion, and the long steady heat it is capable of affording, is well adapted for lime-burning, and large quantities are exported for that purpose; mixed with Clay, so as to form balls, it is also extensively used in Wales for domestic purposes.*

2d. *Free-burning Coal*, locally termed "*Coking, or Iron-making Coal*," also "*Glô spagod, or Branching Coal*," from a peculiar property hereafter to be described. Under this head, I propose to include all the intermediate varieties, between Stone Coal and bituminous Coal, the *larger fragments* of which are capable of being coked, in heaps, although the *small or dust*, from the Coal being deficient in bitumen, *will not adhere and form Coke*. It is inferior in lustre and hardness to Stone Coal; fracture, variable, in some specimens presenting a great number of very small and brilliant facets; cleavage, irregular, and at various angles intersecting each other, and presenting the *peculiar striated surface* sometimes exhibited by the Newcastle Coal in the vicinity of a Dyke. Many thin bands of carbonaceous matter are interstratified with these seams of freeburning Coal. The proportion of constituent parts include a considerable range (*see* the Table at the end of this paper), but an analysis of the Coal, from one of the most characteristic seams, afforded the following results:—

Carbon, or Coke,	82
Volatile Matter, consisting of Gas of very inferior illuminating power, and Ammonia (no Coal-tar passing over),	14½
Incombustible earthy Residuum, in the form of light white Ashes,	3½
	100

* In the cottages of the peasantry in the counties of Glamorgan and Carmarthen, and more especially in Pembrokeshire, these balls form the principal article of fuel. The Culm

The most peculiar and important property possessed by this Coal is the swelling or branching which takes place during combustion, and in the process of coking, which is effected in heaps in the open air. This appearance is altogether different from the swelling exhibited by bituminous Coal under similar circumstances, and frequently gives the Coke an arborescent appearance (hence the term "Glô spagod," or Branching Coal), very materially increasing its bulk, as compared with the Coal from whence it is produced. In some varieties (very well represented by the Clyngwernon Seam, *see* the section,) this property exerts such an effect on the Coke as to make it nearly as light and porous as Wood Charcoal; while in others, as for instance, the Great Seam at Merthyr Tydville, the Coke is much harder and more ponderous, and admirably adapted for iron smelting. The lighter Coke, when free from Sulphur, is used for the manufacturing of Tin-plate. In a common grate, the more bituminous varieties of this Coal emit very little smoke, though a considerable proportion of thin yellow flame; the less bituminous seams, less flame, and no smoke whatever.

The nature of my professional engagements having caused me to make a number of experiments on the heating power of this class of Coals, which have led me to conclude that they possess, for the use of breweries and distilleries, for the raising of steam, and more especially for the purposes of steam navigation, several peculiar and important advantages over any other Coals which have come under my observation.

and Clay, being first thoroughly mixed by the bare feet of one or other of the female part of the family, are moulded into balls of an oval shape, and the good housewives not unfrequently display their taste by the fanciful way in which they place these balls edgewise in the grate, each row being inclined at a different angle; and, under the active influence of that passion for whitewashing (which, extending from the church belfry to the pigsty, adds very materially to the picturesque nature of Welsh scenery), they are not unfrequently, together with the bars of the grate, whitewashed also. These balls are, as may readily be supposed, difficult to ignite, but being once lighted, burn for a great length of time, and being renewed at the top as they slowly consume, the fire is not allowed to go out, in some cases, for many years, such a catastrophe would indeed be regarded by a thrifty housewife as an unlucky omen; the appearance presented by a fire of this description, with various articles of linen, hung up to dry, absolutely in the chimney (for the balls, like Stone Coal, emit neither smoke nor flame), is not a little singular to any one accustomed to the "*bleezing ingles*," and "*black diamonds*" of the north of England.

I may, perhaps, be excused for attempting to describe these peculiar properties a little more in detail. One of the best varieties is procured from the Penprys Seam (*see* the section, division No. 2.), the constituent parts of which have already been given. By careful experiments, on a small scale, since verified in the large way, I have ascertained that 80 parts of this Coal will convert into steam as much water as 100 parts of the best steam-engine Coals of other districts; an increase of heating power fully accounted for by the appearances exhibited in its combustion in the grate of an engine furnace. A layer of Coals, of 4 inches in thickness, when fully ignited, will, by the branching or swelling property, expand into a loose heap, 7 or 8 inches thick, through every part of which the air has a free passage; though burning with a considerable proportion of thin greenish-yellow flame, *it yields no smoke*, and, from the free passage allowed to the air, the heat emitted is so intense as to consume almost every particle of Cinder, so that the only part, not actually applied in heating the boiler, is a very small proportion of the cinder and the incombustible earthy residuum, which fall through the grate in the form of a grey powder; the total amount of refuse, with a proper grate and skilful management, ought not to exceed 7 per cent.; The fire ought never to be stirred, and the heat afforded is, therefore, more regular than from any bituminous Coal; the only attendance required is for the purpose of feeding the fire at proper intervals, and keeping it open at the bottom by letting out the ashes with a small hooked instrument. The advantages of this Coal, in steam navigation, will be at once apparent; 80 tons will answer the purpose of 100; it yields less refuse, and requires a chimney less, both in height and area, than other Coals; and, lastly, it emits no smoke, an invaluable property as applied to steam vessels engaged in war. Its disadvantages are, that it does not readily ignite at first; that, except as Culm, and for the purpose of burning Lime, the small produced in working and transferring the Coal is entirely useless; and that it requires a different system of management, and different sized flues and grates to those in general use; circumstances too little attended to in burning the various kinds of Coal.

Many entire seams of Free-burning Coal work so small as be to inapplicable to any purpose except lime-burning; they are then (in common with the small produced in working the harder seams, and with the small of Stone Coal) called *Culm*. The Clyngwernon and Trosserch seams are of this kind (*see* the section). A considerable proportion of the seams of Free-burning Coal burn to a red-ash, an appearance which is considered as indicating the presence of Sulphur; thus rendering the Coal unfit for the manufacture of Iron; in the majority of cases this is probably correct, the redness in the ashes being caused by a mixture of oxide of Iron, which metal, previous to combustion, would probably exist in the Coal, in the shape of sulphuret of Iron; many of the Culm seams above alluded to possess this property.

It is scarcely necessary to add that for the production of gas, and for smith's purposes, both Stone Coal and Free-burning Coal are entirely inapplicable.

3d. *Bituminous Coal*, technically called "*Binding Coal*," or "*Run Coal*." —Under this head is included all varieties, the small or dust of which is capable of adhering so as to form Coke in ovens. The Welsh bituminous Coals are generally very soft and friable, though some varieties affect the splinty structure (as the Coal from the south-east part of the Basin, shipped at Newport, in Monmouthshire), and cut extremely large. It is of inferior lustre; colour, dull brownish black; in the less bituminous varieties, cleavage striated like the free-burning Coals; specific gravity varying from 1·285 to 1·315. Of the varieties I have examined the range of constituent parts is as follows:—

	Most bituminous.	*Least bituminous.*
Carbon, or Coke,	69	79 per Cent.
Volatile Matter,	28	18 —
Incombustible earthy Residuum, affording in combustion, heavy ashes, of a reddish-yellow colour, generally about,	3	3 —
	100	100

Though very inferior in quantity of bitumen, and consequently in

strength and durability for smiths' purposes, and in no case producing Coke equal to our best coking Coals; many seams of this Coal possess the important property of being more free from Sulphur. Considerable quantities are used, being first mixed with the small of Free-burniug Coal, in the reduction of Copper Ore, and when it can be procured, the Coke of Bituminous is mixed with the Coke of Free-burning Coal, for smelting Iron. Large quantities are also exported to Ireland and to Cornwall for manufacturing and domestic uses; but the large proportion of earthy matter in this Coal, (generally about 3 per cent., while the best Newcastle Coals do not contain more than $\frac{1}{2}$ per cent.) renders it disagreeable for the latter purpose.

For the sake of more easy reference, I have arranged, in the form of a table, a statement of the products afforded by the distillation and incineration of all the different varieties of Stone Coal, Free-burning and Bituminous Coals, that I have had an opportunity of assaying. This table will be found at the end of this paper.

DISTRIBUTION OF THE DIFFERENT VARIETIES OF COAL OVER THE MINERAL BASIN.

Commencing at the western extremity of the Coal-field in St. Bride's Bay, and proceeding eastward, it will be found that the whole of the Coal seams extending through Pembrokeshire, both on the north and south sides of the Basin, consist of Stone Coal. Passing across Carmarthen Bay, and continuing to proceed eastward along the centre of the Basin, it will be found that the seams rising northward, near the centre (with one or two exceptions), are Free-burning Coal, underlaid by by others, passing gradually into Stone Coal, further northward; while the seams rising to the south, consist entirely of Bituminous Coal, their quantity of bitumen increasing as they recede from the centre to the south edge of the Basin. The gradual change of quality that takes place here will be fully explained in referring to the section. On proceeding further eastward towards Swansea, the respective qualities of the seams, on each side of the centre, are still preserved. Beyond this point the exact position of the centre of the Basin has not been so

well identified; but it may still be given as a general character that the north-crop seams are Free-burning Coal, underlaid by others passing into Stone Coal as they approach the Limestone; and the south-crop seams retain their bituminous quality until they approach the eastern termination of the Basin near Pontypool, where, by a diminution in their quantity of bitumen, they become changed into Free-burning Coal. Between the head of the Neath valley and Hirwain, about 25 miles from Pontypool, the *north-crop* seams, by an increase of their proportion of bitumen, are also changed from Stone Coal into Free-burning Coal, which thus becomes the prevailing character of the seams cropping out around the eastern termination of the Basin.* From this circumstance, as well as from the abundance of Iron-stone, alternating with and underlying the lower seams of Coal, added to the flatness and regularity of the strata, this part of the Coal-field has become the site on which the principal Iron works of South Wales are erected, and from which they procure their immense supplies of Coal and Iron Ore.

Of these varieties, there is by far the greatest available quantity of Stone Coal yet unworked, and, ranging along the elevated ground forming the northern edge of the Basin, a very large proportion of it is attainable by level.

Of the Free-burning Coal, great quantities have been already, and are daily, consumed by the Iron works in the north-eastern part of the district. An extensive tract, along the centre of the Basin, is yet unworked; and it possesses, in common with the Stone Coal, all the advantages arising from its position in the more elevated parts of the district.

Of the Bituminous Coal there is an immense tract along the southern edge of the Coal-field; but the great inclination of the strata, and the comparatively low ground, beneath which the bituminous seams extend,

* Whether the vicinity of the Trap and Transition rocks can, at any remote period, have had a tendency to deprive the Coal of its bitumen, I must leave to those better acquainted with geological phenomena to decide; but the existence of Stone Coal in every part of this basin which is either underlaid by the Trap, or nearly approached by the Transition rocks, is, to say the least of it, a singular coincidence. An examination of Greenough's *Geological Map*, together with the above description of the tracts occupied by the different varieties of Coal, will render this fully apparent

will render the working of these seams, beyond a moderate depth, expensive, and in many cases impracticable.

OBSERVATIONS ON THE STRATA, IN THE LINE OF THE SECTION *(see Plate* XI.*)*.

The northern extremity of the section commences at the outbreak of the Limestone, on Mynydd Mawr (or the Great Mountain), in Carmarthenshire, at about two miles to the west of the village of Llandibie, which is nearly half way between the western and eastern extremities of the Basin; from hence the line passes southward in the direction of the dip of the strata, to the Llwchor River near Plâs Llanedi, about $3\frac{1}{2}$ miles above the bridge at Pont-ar-ddulais, where the mail road to Milford crosses that river. This part of the section, 5 miles 700 yards in length, *forming the 1st division*, is constructed from a survey made in the year 1825.

The Old Red Sandstone forming the basis on which the Limestone reposes, is of very great thickness; its upper part is conformable to the Limestone, but its lower beds pass by insensible degrees into Greywacke Slate, at about 2 miles to the northward. The surface descends rapidly in that direction under the bolder and more elevated escarpment formed by the Limestone and Millstone Grit.

The Carboniferous Limestone occurs in layers of from 2 to 7 feet in thickness, between which, thin beds of Shale are occasionally interposed: its aggregate thickness is 120 fathoms, and its dip or inclination in the direction of S. $11\frac{1}{2}°$ W. at an angle of 29°. Its general character is that of a compact blue Limestone, but some of its lower beds pass into black Marble abounding in Encrinites, and are quarried at various points along their line of basset. Although this Limestone has been so extensively quarried, I am not aware that veins of Lead Ore of any consequence have been found to intersect it.

The Millstone Grit forms a line of barren hills immediately within the outbreak of the Limestone, the rock frequently rising to the surface; it is composed of a number of beds of Chert and Conglomerate, alternating with each other, and the former occasionally contains vegetable organic remains; its aggregate thickness is 85 fathoms. This forma-

tion is expressively termed by the Welsh miners the "Farewell Rock," from the position which it occupies beneath the whole of the beds of Coal and Iron-stone contained in the mineral Basin.

Immediately upon the Millstone Grit, repose a thick series of Shale beds, alternating with thin bands of hard Sandstone. The first visible seam of Coal occurring in the Shale is 2 inches thick; it is very probable however, that another seam called the "Rhos Vach," generally about 2½ feet thick, crops out here. A few fathoms above this seam there occur from 14 to 16 beds of Iron-stone, 9 of which are visible at the surface; they are embedded in Shale, and occupy a perpendicular depth of 13 or 14 fathoms. Continuing their range to the eastward, these are the principal beds from which the supply of Ore for the Welsh Iron works is procured. At Cillia, a few miles to the eastward of the line of section, a fine natural section has been washed by the rapid stream of the river Twrch. These beds of Iron-stone are of an average quality, the specific gravity of three specimens which I have examined were 3·30, 3·25, and 3·28 respectively; they were obtained from the out-break of the beds, and making allowance for the partial decomposition consequent on their exposure to the atmosphere, they may be considered as capable of yielding on the average, about 26 per cent. of Iron. In addition to these beds, several others of which no correct account could be obtained, are interstratified with the different seams of Stone Coal which follow next in succession.

These Stone Coal seams are ten in number, or, if the bands of Shale which commonly separate the 8th, 9th, and 10th seams, be considered as dividing them into distinct beds, the total number will be 13. There is no apparent cause for the undulation in their line of dip, an irregularity which does not take place to any great extent along the level line or drift of the strata. These seams vary considerably in point of hardness, and in the quantity of sulphur which they contain; in other respects they present no great variation in quality, and possess all the decided characteristics of Stone Coal. These are the seams, from which, (being changed into Free-burning Coal) the principal supply for the Iron works in the N. E. part of the Basin is obtained. In their range to the westward, by way of Llanon, Pont-y-berem, Trimsarren

and Kidwelly, where they enter Carmarthen Bay, they present no variation in quality, except at Trimsarren, where an increase in its proportion of bitumen, materially adds to the heating powers of the Coal.

The bar of rock which occurs in the shape of a vertical bed of Sandstone at Cwm Nant-y-Tarw, distorts the strata for a considerable distance on the south side, and changes their line of dip from SW. to S. Amid the confusion caused by this bar, seven or eight beds of Ironstone imbedded in Shale, may be observed cropping out in the brook to the east of the line of section. The remaining six seams delineated in this division are Stone Coal; although they are imbedded in Shale, and interstratified with beds of Ironstone, Sandstone begins to occur in beds of considerable thickness. Assuming that the two supposed seams on Mynddbach Llanedi, and Nos. 1 and 7 on Mynydd Mawr, amount to 9 feet, the aggregate thickness of the workable seams of Coal, in this division will be 60 feet.

Of the beds of Iron-stone, the series which occur, under the principal Coal seams on Mynydd Mawr, will alone amount to about 4 feet 3 in., and calculating that the beds interstratified with the Coal seams, together with those cropping out at Cwm Nant y Tarw, will amount to 40 inches; the aggregate thickness of Iron-stone in this division will be $7\frac{1}{2}$ feet.

The proportion of this abundant deposit of minerals, which may be obtained by a level driven from the Llwchor River to the north, will be seen, by following the line shewing the level of high water-mark, from that point to the Limestone. When it is taken into consideration, that this division of the section terminates in a valley, down which a line of railroad might be laid to deep water in the port of Llanelly, a distance of $10\frac{1}{2}$ miles, with a gradual descent amounting to 40 feet, there is perhaps no part of the Welsh Coal Basin, so well calculated to shew the important advantages to be derived from the discovery of any method, by which Stone Coal might be applied as a substitute for Coke, in the smelting of Iron Ore.

Division, No. 2. commences at a point 5 miles to the westward of the termination of No. 1.; the space between, being, as nearly as could be ascertained, in the water-level direction or drift of the strata.

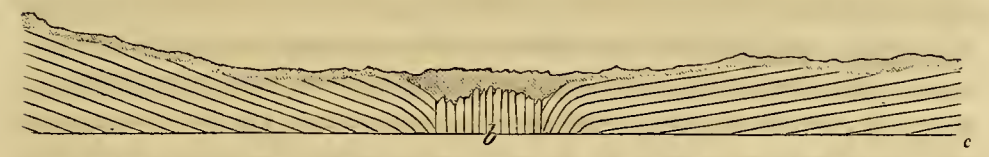
This division commences therefore, as far as regards the stratification, at the point where No. 1 terminates Beginning in the bed of the Daven rivulet, nearly 2 miles S. E. from the village of Llanon, the line proceeds southward until it again intersects the Llwchor River, about three quarters of a mile below the town of Llwchor, and terminates on a marsh called Morva Llew, in Glamorganshire; its length being $5\frac{3}{4}$ miles, and its general direction S., 10° W. This division is constructed from a variety of surveys, and from sections obtained by the different operations of sinking, boring, driving levels, and working Coal, connected with the opening out of two Collieries under my direction, nearly in the line of section. Beginning at its northern end, the strata, for upwards of a mile, are composed chiefly of a hard coarse Sandstone, containing 2 or 3 thin beds of Coal, or rather that variety of Free-burning Coal, which, from its soft quality, has already been described as "Culm." This series of thick Sandstone beds would appear to be equivalent to the Sandstone called the "Pennant Rock," which separates the lower from the upper Coal seams, near the eastern termination of the Basin. The "Trosserch seams," the most northern represented in this division, and of which I cannot now ascertain the thickness, are both composed of free-burning Culm, as are the next above them, the "Clyngwernon seams," 40 to 50 fathoms above which occurs the seam of Free-burning Coal called the "Penprys seam," which, at a distance of 300 yards to the westward of d^2, (*see* the section,) is overlaid by a $2\frac{1}{2}$ feet seam of Bituminous Coal called the "Gelle Gille seam." Between these two latter seams there is an interval of about 90 fathoms, in which two or three thin beds of Coal occur. The Gelle Gille is not only remarkable as being the only seam of Bituminous Coal rising to the northward in this part of the Coalfield, but it is probably the highest seam in the whole mineral Basin. Although barely coming within the range of Bituminous Coals, and and consequently being only weak for smiths' purposes, yet, owing to its extreme freedom from sulphur, considerable quantities are exported for that purpose from Llanelly to Brittany. The peculiar qualities of the Penprys seam have been already described under the head of Free-burning Coal.* From the Penprys pits, 23 fathoms to this seam, con-

* An extensive tract of this seam will shortly be won by means of a pit, which I set off

siderable quantities have been already shipped to London under the denomination of "*Llangennech Coal.*" Up to the point shewn on the section by the letter C, the line proceeds in the direction of "full dip"; the general inclination of the strata from the northward to the Freestone quarry, about 150 yards south of the Penprys pits, being about 12½°, or about 16 inches per fathom; at this quarry, and southward until they reach the centre, the dip does not exceed 8°, or about 10 inches per fathom, and near to the centre it is probably even less. Owing to a change in the *direction* of the dip of 80° to the westward (viz. from S. 20 W. to N. 60° W.), the line proceeds along the water-level course of the strata from *c*, to the centre at *d*.

The direction of the centre, or trough, technically called the "Saddle," at the point where it is crossed by the section, is about N. 66° W. and *nearly parallel*, therefore, to the dip of the strata on its northern side; whereas on its south side the line of dip and rise immediately changes to about S. 30° W., thus forming a right angle with the dip and rise line on the north side. This change can, I think, only be accounted for by supposing that the strata, being broken in the centre, have slipped downwards on its south side. That a break in the strata has actually taken place, will be made fully apparent by the following section taken at Pencoed, about half a mile to the eastward of the point where the line of section crosses the centre.

SOUTH. DIAGRAM, No. 1. NORTH.



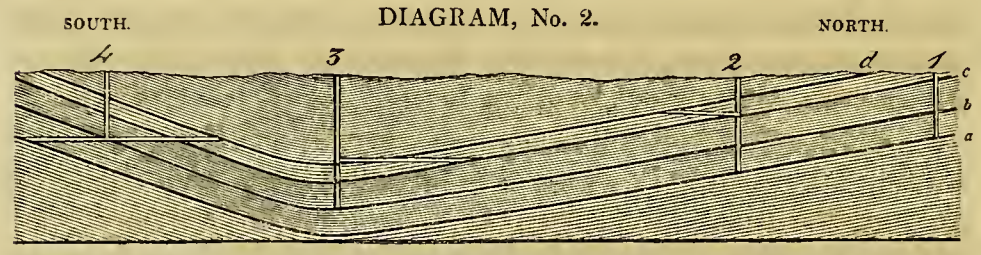
The strata (*c*) on the north side of the centre (*b*) dip to the S.W. at the rate of about 12 inches per fathom, and the strata (*a*) on the south side rise to the south at the rate of about 25 inches per fathom. The rock in the centre for several yards is perfectly vertical, and seems to be composed of the broken edges of the inclined strata on each side, which are composed of hard Sandstone.

That this break in the strata and change of their dip and rise line is only of partial extent, at least to the westward, will be shewn by the

at a few hundred yards to the west of the line of section, and named, in honour of the Patron saint, the St. David Pit.

following section, taken in the centre of the Basin at Llanelly, (about $2\frac{1}{2}$ miles to the west of diagram, No. 1.)

DIAGRAM, No. 2.



Numbers 1, 2, 3, and 4, are the pits by which the strata have been proved. The pit No. 3 is put down within 30 yards of the centre of the Basin; the seam (*d*), 2 feet in thickness, locally termed the "Rosy Vein," was intersected at the depth of 57 fathoms:—the seam (*c*), 4 feet in thickness, called the "Fiery Vein," at 67 fathoms; and the seam (*b*), 2 feet thick, and called the "Golden Vein," at the depth of 85 fathoms. The lowest seam (*a*), 2 feet in thickness, and known by the name of the "Bushey Vein," has been proved by the other pits, and would be found here at the depth of about 103 fathoms. It does not appear that any change takes place here in the *direction* of the dip and rise line, on the opposite sides of the centre, nor does any break in the strata occur, similar to that exhibited in Diagram, No. 1., although several small faults, known in our northern districts by the name of "hitches," intersect the strata near the centre. The inclination, in accordance with the general law, which seems to influence the strata throughout the whole of the Basin, is greater on the south than on the north side. The quality of the seams of Coal delineated in the above Diagram, undergoes a gradual variation from north to south; the north crops of the seams being composed of Free-burning Coal, becoming more bituminous as they approach the centre, and passing into decided Bituminous Coal on its southern side.

The workable seams of Coal rising to the northward in this division, including the Gelle Gille seam, which crops out to the west of the line of section, will be six in number; and assuming that the Trosserch seams and two others, not shewn on the section, which are supposed to crop out to the north of them, are together 10 feet, their total thickness will amount to 25 feet. The aggregate thickness, therefore, of the workable seams on the north side of the centre will be 85 feet, and their number 27.

The line of section, after crossing the centre or "saddle," proceeds in the direction of the full rise of the strata (about S. 30° W.) to the bank of the Llwchor river. The first south-crop seam, called the "Fiery Vein," is 7 feet thick, and lies at a distance of from 40 to 50 fathoms above an 8 feet seam, called the "Golden Vein," which at a former period, has been extensively worked to the depth of 40 fathoms,

by means of the Genwen Engine Pit, 800 yards to the westward. The inclination of these two seams near the crop is upwards of 18½°, or 24 inches per fathom: they are underlaid at a considerable depth (probably from 90 to 100 fathoms) by the "Carnarvon or Boccas seams," 7 fathoms apart, the upper of which is 4 feet, and the lower 3 feet in thickness. The pits by which these four seams were explored, have ceased to work many years ago, and I could not therefore obtain any specimens of the Coal for examination, but they bear the reputation of being excellent binding-Coal, and there can be no doubt that their proportion of bitumen considerably exceeded that of the Gelle Gille seam. About one mile to the eastward of the Carnarvon pits, and as nearly as can be ascertained, in the water-level direction of the strata, is situated the Llwchor Colliery. There appears every reason to suppose that the upper seams of Coal there found, are the same as the Carnarvon seams, and if so, the lowest seam at Llwchor Colliery must also be found under the 3-feet seam at Carnarvon. The Engine pit at Llwchor intersects, at the depth of 15 fathoms, a seam of 2½ feet in thickness, at 25 fathoms, another seam of 2½ feet, and at 45 fathoms, a seam of 5½ feet in thickness; the latter, which is of very good quality and texture (*see* the table) is not known at Carnarvon Colliery, but this may in all probability be owing to the circumstance that the crop or outbreak between the two points traverses a part of the sandy bed of the river, and for the remainder of the distance, across a thick alluvial deposit, forming part of an extensive marsh, bounding its northern bank. The line of section now crosses the river, at an angle of about 50° to the eastward of the full dip of the strata, a deviation which was necessary for the purpose of reaching the opposite bank, at a station behind the outbreak of the six seams of coal next in succession. The strata in this interval are concealed by the sands forming the bed of the river, but an idea of their position may be obtained by observing the course of the strata to the south of the Llwchor Colliery, which, as has been before stated, is about one mile to the eastward; the seams of coal found in this colliery, rise to the southward at the rate of about 10 inches per fathom, for upwards of half a mile, when they reach the summit of the hill on

which stands Llwchor Upper Town; from hence the strata appear to change their inclination and dip southwards, until concealed under the marsh, the western part of which is crossed by our line of section.

Assuming that this contortion extends under the sands to the westward and equally affects the strata in the line, the real depth between the Carnarvon seams and the first of the next series, called the "Bancog Seam," will be much less than would otherwise be inferred from the distance between them, if, indeed, a down-throw Dyke to the southward, of considerable magnitude, do not intervene; an occurrence strongly indicated by the contortion of the strata already noticed, by the great inclination of the Bancog and subordinate seams, as compared with those at Carnarvon and Llwchor Collieries, and by the non-existence of any other seams of Coal on the north side of the centre which will at all correspond to the six seams cropping out on the Marsh. The first and second of these seams, the "*Bancog* and the *Fraith*" are, I believe, of inferior quality, the next three have been proved by the sinking of the Dunraven Pit, at the Adair Colliery, about one mile to the east of the line. The first of these, called the "9-*Feet Seam*" (although it is in reality 11 feet in thickness) is a very pure Bituminous Coal, but soft and friable in its texture; it was intersected at the depth of 40 fathoms. The next, the "*Glo-braisc*," or Big Coal Seam, 65 fathoms below the 9-Feet, is 4½ feet in thickness; it is more bituminous, and approaches more nearly to Newcastle Coal, both in quality and texture, than any other Welsh Coal that I have seen. Ten or twelve fathoms below this the *Yard Seam* occurs, and a few fathoms lower a seam of inferior Coal, 2 feet in thickness, crops out. The strata in the Dunraven Pit, to the depth of 40 fathoms, dip at an angle of 30°, or about 42 inches per fathom; here the 9-Feet Seam after being intersected by a slip 6 feet down to the northward, dips about 22½°, or 30 inches per fathom; the deeper seams, owing to the hade or underlay of this slip to the northward, will be intersected by it considerably to the dip of the Dunraven Pit, and their inclination will, in all probability, undergo the same change. These seams continuing their range to the eastward by way of Ystrad, Mynydd-bach-y-Glo (*i. e.* the Little Mountain of Coal), pass to the northward of the

Town Hill and Kilvey Hill, behind Swansea, and are, I believe, considered to be the same seams that are now worked at Llansamlet Colliery. Immediately to the westward of the line of section they enter the Llwchor or Burry River, and are lost in Carmarthen Bay.

The south-crop seams in this division (including the 5-Feet seam at Llwchor Colliery not shewn on the section) are eleven in number, and their total thickness will be 52 feet; they are all of a binding quality, and the gradual increase of bitumen which takes place in passing from north to south, will be seen by referring to the table at the end of this paper. The Genwen seams, the Llwchor 5-Feet seam, and the Dunraven Pit Yard seam, are overlaid by beds of Sandstone; the remainder are imbedded in Shale, occasionally containing beds and nodules of Ironstone, portions of the Shale being sometimes of a deep red colour, apparently from a mixture of Oxide of Iron. The Dunraven Pit, 110 fathoms deep, 107 of which is below the level of high-water mark, was sunk under my direction, in the year 1827, and, what is rather an unusual occurrence, without the assistance of a pumping engine, the quantity of water not exceeding 600 gallons an hour. This may be attributed to the impervious nature of the Shale through which the pit was sunk, and to the probable existence of a Dyke to the south, communicating with two others, one on the east and one on the west side, already known, and which, acting as dams, insulate the strata for a considerable distance round the pit.

Division, No. 3. commences at the termination of No. 2, and proceeds in the direction of full rise to the south-crop of the Limestone, at a point upwards of a mile and a half to the N. W. of the village of Ilston, in the district of Gower. Not having surveyed this division, the line of surface is drawn from recollection, and from a general knowledge of the district. For a list of the greater part of the seams of Coal which it contains, and of their respective thicknesses and distance from each other, I am indebted to a friend now residing in the neighbourhood. The first workable seam in this division is the *Sluice Pill 5-Feet Seam*, it is, I believe, of very excellent quality, and has a strong Sandstone roof. The *Hendy Seam*, $3\frac{1}{2}$ feet, and the *Big Seam*, 5 feet, have been partially worked at

Penclawdd. The angle of inclination gradually increases in advancing to the southward until the lowest beds become elevated to about 45, or 6 feet per fathom, and upwards; the whole of the seams have nevertheless been worked to a certain extent principally for the household consumption of the inhabitants; they are all bituminous, but the greater proportion of them very soft and tender, and of very inferior lustre; owing, however, to their general freedom from Sulphur they are very well adapted for many manufacturing purposes.

The seams in this division are twelve in number, and their total thickness 52 feet; the number of seams cropping out to the south of the centre will, therefore, be twenty-three, and their aggregate thickness 104 feet; thus exceeding, by 19 feet, the seams known to occur on the north side of this part of the Basin, although the north-crop seams are twenty-seven in number. This difference may, in some measure, be accounted for by the greater inclination of the south-crop seams, tending to increase their *perpendicular* thickness, which, as regards those furthest south, has probably been given instead of the *real* thickness. The great thickness of the interposing beds of Shale and Sandstone near the southern, as compared with the northern edge of the Basin (which will be at once perceived on comparing the two ends of the section) renders it probable that the *whole formation, Coal seams included, thins out in approaching the north.*

The south crop of the underlying beds of *Iron-stone* have not, to my knowledge, been observed in the district crossed by the section, but there can be no doubt of their existence, as they have been worked on the opposite, or western side of Carmarthen Bay; and at a place called Cefn Cribbwr, near Pile, on the east side of Swansea Bay, they may be seen interposing between the lower Coal seams and the Millstone Grit.

I am not aware of the thickness of the Millstone Grit and Limestone at their south crop; the Limestone is very compact, the lower beds crystalline, and abounding in Encrinites; on the east side of the promontory of Gower it is variegated, and has been quarried for Grey Marble. It has been already observed that the Limestone, by a change in its dip to the southward, extends into the Bristol Channel, where it probably forms another Trough or Basin containing Coal Measures.

The following detailed Vertical Section of the Strata, commencing a few fathoms beneath the "Fraith Seam" (*see* the south end of division No. 2) will shew the nature of the intervening beds with which the Coal seams near the centre are associated. The strata in this section, chiefly argillaceous, are immediately underlaid by a thick series of Sandstone beds intervening between the central and lower Coal seams, which latter, as well as the principal beds of Ironstone, are interstratified with Shale.

SECTION.

	Fms.	Ft.	In.
Soil and Clay,	1	0	0
Clay and Gravel,	1	3	0
1. Soft Grey Metal Stone, with Clay partings,	2	2	0
2. Strong Grey Metal, with soft partings,	0	2	10
3. Strong Grey Metal, mixed with Post and soft partings,	1	0	2
4. Strong Grey Metal, mixed with Grey Post,	2	2	9
5. Soft Blue Stone, with Clay partings,	2	5	0
6. Grey Post, mixed with Whin,	1	0	0
7. Grey Post, mixed with Blue Metal Stone,	2	0	0
8. Grey Post, mixed with Blue Metal Stone, and Whin Girdles,	1	3	0
9. Grey Post, mixed with Blue Metal Stone, with soft partings,	3	0	0
10. Blue Stone, with "Rimers," or streaks of *Coal,*	1	1	9
11. Grey Metal Stone, with black streaks,	1	0	0
12. Foul *Coal,*	0	0	3½
13. Black Stone, mixed with Coal,	0	1	8½
14. Soft Grey Thill, with streaks of *Coal,*	1	5	0
15. Foul *Coal,*	0	0	9
16. Soft Grey Thill,	0	5	3
Carried forward	24	3	6

	Fms.	Ft.	In.
Brought forward,	24	3	6
17. Grey Post,	1	0	0
18. Grey Post, mixed with Blue Stone,	2	0	6
19. Blue Metal Stone,	1	0	0
20. Black Stone, with streaks of *Coal* from ¼ inch to 2 inches thick,	1	0	6
21. Black Stone, mixed with *Coal,*	0	2	6
22. Soft Grey Post, mixed with Whin,	0	3	0
23. Strong Grey Post, mixed with Whin and Grey Metal Stone,	6	2	0
24. Soft Grey Metal Stone, with "Bolses," or nodules of *Coal,*	0	5	4
Great, or 9-Feet Seam, consisting of—			
25. *Coal,* 1 5 4			
26. Black Stone, mixed with *Coal,* 0 1 6			
27. Bottom *Coal,* 0 1 6			
	2	2	4
28. Soft dark Grey Thill, with nodules of Ironstone,	1	2	6
29. Soft Black Stone,	0	1	0
30. Soft Grey Thill, mixed with Post and nodules of Ironstone,	0	2	0
Carried forward,	42	1	2

37·5·4

	Fms.	Ft.	In.
Brought forward, ...	42	1	2
31. Grey Metal, mixed with Post and nodules of Ironstone,...	12	4	0
32. Red Shale, mixed with nodules of Grey Post, ...	5	0	6
33. Grey Post, ...	3	3	6
34. Red Shale, with nodules, ...	6	2	6
35. Grey Post, with Clay "backs,"	2	2	0
36. Red Shale, mixed with Blue Metal Stone, ...	2	2	4
37. Strong Grey Post, ...	5	0	0
38. Grey Metal Stone, mixed with Post and Blue Stone, ...	4	1	2
39. Strong Grey Whin,.....	1	0	0
40. Strong Blue Stone, ...	1	2	10
41. Blue Metal Stone, ...	2	0	6
42. Strong Grey Post, ...	3	0	0
43. Soft Blue Stone,.....	0	0	10½
44. Foul *Coal*, mixed with Black Stone, ...	0	0	6½
45. Light Grey Thill,.....	0	0	9½
46. Foul *Coal*, mixed with Black Stone,.....	0	1	8
Carried forward,...	92	0	4½

	Fms.	Ft.	In.
Brought forward, ...	92	0	4½
47. Dark Grey Thill, ...	0	2	4
48. Black Stone, mixed with *Coal*,	0	0	9½
49. Foul *Coal*,.....	0	1	6½
50. Dark Grey Thill,.....	1	1	4
51. Grey Metal Stone,.....	1	2	10
52. Black Stone, with beds of *Coal* from 3 to 8 inches thick,.....	1	2	4
53. Strong Grey Post,.....	1	2	0
54. Ditto, with "*Coal Pipes*," and Blue Stone, ...	2	4	0
55. Grey Post, with soft Grey Metal "backs,".....	2	0	0
56. Soft Black Stone, ...	1	0	6
57. Glô Braisc, or Big Coal Seam, ...	0	4	6
58. Soft Grey Thill,.....	1	0	0
59. Soft Grey Post,...	1	0	0
60. Very strong Grey Post, ...	2	2	6
Total, ...	109	1	0½

From 7 to 9 fathoms deeper the Yard Seam is found.

The nature of the Coal seams in the above Section, has been already described. The different strata have been named according to the terms made use of in the Newcastle Coal District, on the presumption that they would be best understood, and, in the absence of any general, or scientific terms, sufficiently descriptive of their nature. It is greatly to be regretted that no general class of names has hitherto been adopted for the different strata occurring in Coal-fields, and, as having a probable tendency to facilitate this desirable object, the following explanation of the terms made use of in the above section may not, perhaps, be deemed uninteresting.

Strong Grey Post, the "Quarr" of the Welsh Miners, "Grey Rock" and "Rock binds" of Staffordshire, is a Sandstone nearly equivalent to the "Post" of the Newcastle Coal-field. Throughout the Welsh Coal district it is, however, generally much darker coloured, apparently from a mixture of Carbonaceous matter; it is usually intersected by a great many backs or partings, and hence, in sinking, wherever the strata are highly inclined, it becomes necessary, notwithstanding the hardness of the Sandstone, to secure the sides of the pits by walling or timber. Owing to the same cause it is also generally an inferior building stone. The term *Grey Post* is applied to such of the beds as are softer, and contain a greater proportion of Argillaceous matter than Strong Grey Post.

Grey Metal Stone is the name given to strata containing a still greater proportion of Argillaceous matter than Grey Post, but which are gritty to the touch, and retain in some degree the structure of Sandstone.

Grey Metal is a decided Shale, a little harder and coarser than *Blue Metal.* From their lamellar structure, Grey and Blue Metal are called by the Welsh Miners, "Cliff or Clift," and "Plate" by the Northern Lead Miners; in Staffordshire, and the central Coal districts, "Bind or Clunch." The term *Blue Stone* is applied to a variety more massive in structure. *Grey Thill*, or *Thill*, is a name given to the peculiar bed of massive indurated Clay, which generally forms the "sill" or floor of a seam of Coal.

Black Stone, the "Black batt," of Staffordshire, is a Bituminous Shale, which very generally forms the immediate roof of a seam of Coal.

The term *Whin*, used in the above section, and so frequently occurring in the sections of the Newcastle Coal-field, is applied to a hard, brown, massive Sandstone, which neither in appearance nor structure bears any resemblance to Basalt. It usually occurs in thin irregular beds, or compressed nodules, called "Whin Girdles," which, though of minor consequence in sinking, often materially retard the process of boring. These nodules, I have been informed by Mr. Winch, principally consist of Felspar, and are fusible at a moderate heat.

The colouring matter of the *Red Shale*, of which three beds occurred in this section, was different from any thing of the kind that I have seen in the north. It appeared to have been held in solution by water at some former period, and to have been forced, as if by strong pressure, into the minutest fissures in the Shale, which was of a purplish carmine colour, and the water drawn out of the pit had a very delicate pink tinge. I have seen a somewhat similar bed of Shale in Staffordshire.

GENERAL OBSERVATIONS.

Faults, or Dykes. An examination of the section would lead to the inference that the Welsh Coal district is unusually free from the dislocations, known here by the name of "Upcast, or Downcast Dykes," and in that country, by the name of "Faults, or Bars;" but the very small number intersected is owing to the bearing of the Dykes, which, generally speaking, run in a north and south, or dip and rise, direction, and nearly parallel therefore, to the line of section. A section taken for the same distance (15 miles) along the water-level line, or drift of the strata, would exhibit a more than ordinary proportion of those dislocations. About two miles to the eastward of the point where the northern end of the line commences, a Dyke, of many fathoms downthrow to the east, passes alike through the Coal Measures, Millstone Grit, and Limestone, considerably extending the width of the mineral Basin. A similar Dyke

intersects the strata near Pontneath Vaughan, and produces the same effect, increasing the width of the Basin, on its eastern side. At about half a mile to the west of Penllwyngwyn (*see* the section, division No. 2), a similar Dyke of 90 or 100 fathoms downthrow to the eastward, repeats and extends the Penprys and Clyngwernon seams in that direction, the former of which would not otherwise have reached the point where the section crosses the Basin; and, following the water-level course of the strata to the eastward, from the termination of division No. 2, a number of Dykes, of less magnitude, occur within the space of three miles. There are many others, of greater or less consequence, but my observations in this extensive district, have not been so minute as to enable me to give their direction and effects. It may be observed, that the great inclination of the strata, and the numerous out-breaks of the seams of Coal afford the means of ascertaining the downthrow of the north and south Dykes, which may be calculated from the extent to which the strata are protruded or extended forward on their downcast side. In addition to these Slip Dykes, the Welsh Coal Seams are liable to irregularities, which, though less decisive in their effects, are of a much more troublesome nature; they are called by the miners "*Rolls*," and their occurrence is marked by the irregular and variable thickness of the seam of Coal affected by them, which, in some cases for several hundred yards together, will be repeatedly contracted and enlarged from 4 or 5, and even from 10 or 15 feet, to 2 or 3 inches; the quality and texture of the Coal being almost entirely destroyed. These Rolls, unlike the Slip Dykes, only affect, generally speaking, particular seams, and do not extend equally to the overlying and underlying strata. Although *Trap*, irregularly stratified, occurs extensively among the lower members of the Coal formation in Pembrokeshire, I am not aware that any Trap Dykes traverse the eastern or principal part of the Basin.*

Fire Damp. The quantity of Carburetted Hydrogen Gas, occurring in

* The Pembrokeshire district is, I believe, intersected by one or more Trap Dykes. An account of the effect produced on the Stone Coal in contact with the Dyke, could not fail to be interesting. Judging from the nature of the Coal, it is very probable that it will be little, if at all, changed in its appearance.

the Welsh collieries, is very trifling, as compared with the Durham and Northumberland districts; this may, in some degree, arise from the greater inclination of the strata allowing the Gas to find its way to the surface between the planes of the different beds; that it cannot be altogether attributed to the great inferiority of the Welsh Coals, for the *artificial* production of Gas is evident, from the remarkable fact that the Stone Coal Seams generally abound more in Fire Damp than the seams of Bituminous Coal.

OBSERVATIONS ON THE QUANTITY OF COAL CONTAINED IN THE MINERAL BASIN.

To estimate correctly the quantity of workable Coal contained in this district, is rendered extremely difficult by the position of the strata, for, owing to the high angle at which they are, generally speaking, inclined, the greatest proportion of the lower range of seams, in the centre of the Basin, will lie at a depth which our present knowledge of mining has taught us to look upon as inapproachable. The available proportion of any seam or class of seams also varies according to the angle of inclination, which, as has before been stated, varies in every part of the Basin.

The lowest range of seams, for instance, which are about 60 feet in aggregate thickness, will occupy an area of about 700 square miles, and would yield (did their depth not exceed 200 fathoms, and at a moderate angle of inclination) upwards of thirty thousand millions of tons of Coal; yet, it is very probable, that not more than one-third of that quantity will ever be obtained from them. The upper seams, on the other hand, while they occupy a much less surface of country, are capable of being worked to a greater extent from the crop or out-break of each seam, owing to their lesser degree of inclination and the more moderate depth they attain. Near the eastern termination of the Basin, however, the great elevation of the country, and the regularity and flatness of the strata, render available a much greater proportion of the Coal. Under all these circumstances, it may be estimated, as an approximation, that the quantity of *workable Coal does not exceed sixteen thousand millions of tons.*

CONSUMPTION AND EXPORT OF COALS.

The home consumption of Coals for the smelting of the Iron Ore raised in the district, and of the Copper Ore imported from Cornwall, is very great.

	Tons.
The quantity of Iron annually manufactured in Wales has been calculated at about 270,000 tons. Of this quantity a proportion of about three-fourths is made into bars, and one-fourth sold as pigs and castings. The quantity of Coal required for its manufacture on the average of the whole, including that used by engines, workmen, &c. will be about $5\frac{1}{2}$ tons for each ton of Iron; the annual consumption of Coal by the Iron works will therefore be about,	1,500,000
The quantity used in the smelting of Copper Ore, in the manufacture of Tin Plate, forging of Iron for various purposes, and for domestic uses, may be calculated at	350,000
HOME CONSUMPTION,...	1,850,000

The quantity of Coals and Culm exported from Wales in the year 1828, was as follows, viz :

	Tons of Coal.	Tons of Culm.		Coal and Culm.	
Cardiff,	32,109	——	=	32,109	
Newport,	422,878	——	=	422,878	
Swansea,	144,198	195,213	=	339,411	
Llanelly,	84,386	7,758	=	92,144	
Milford,	8,303	10,051	=	18,354	
	691,874	213,022	=		904,896
CONSUMPTION AND EXPORT,...					2,754,895

Of the quantity exported there are sent to Cornwall, and other ports	Tons.
on the S. W. Coast of England,	687,041
To Ireland,	209,288
To the British Colonies,	3,895
To Foreign Countries,	4,672
	904,896

The following statement of the rise and extent of the Iron Trade of Great Britain was published in the *Edinburgh Philosophical Magazine*, for December, 1828. It is hoped that its intimate and extensive connection with the present subject will afford a sufficient apology for its insertion here :—

"In the year 1740 the whole of the Iron made in Great Britain was ..... 17,000 tons from 59 furnaces.

——	1788	———	68,000 —	from 121 do.
——	1796	———	125,000 —	
——	1806	———	259,000 —	
——	1820	———	400,000 —	
——	1827	———	690,000 —	from 284 furnaces.

"The different parts of the kingdom in which it was made are as under:—

In Staffordshire, ...	216,000 tons	from	95 furnaces.
In Shropshire, ...	78,000	—	31 do.
In South Wales, ...	272,000	—	90 do.
In North Wales, ...	24,000	—	12 do.
Yorkshire,.....	43,000	—	24 do.
Derbyshire, ...	20,500	—	14 do.
Scotland, ...	36,500	—	18 do.
	690,000 tons.		284 furnaces.

"About three-tenths of this quantity are of a quality suitable for the foundry, and which is all used in Great Britain and Irelaod, with the exception of a small quantity exported to France and America. The other seven-tenths are made into bars, rods, sheets, &c. of which a large quantity is exported to all parts of the world."

From the above statement it will be observed that the quantity of Iron smelted in Wales is upwards of one-third of the total quantity made in Great Britain, and that the produce of the Welsh furnaces considerably exceeds the average of other districts; a circumstance which may, doubtless, in some degree, be attributed to the greater size of some of the Welsh furnaces, and to the less refined state of the metal they produce; but much is owing to the different basis on which the Welsh Iron works are conducted, at least, as contrasted with those in the central parts of England, where the Iron smelter, generally speaking, is the proprietor of the furnace only, and purchases his Coal and Ore from the miner; and thus, a less capital being required, the manufacture of Iron in these districts is in a great variety of hands. In Wales, on the contrary, the smelter is generally the lessee of an extensive tract of Coal and Iron Ore, upon which he has embarked a large capital in the erection of a number of furnaces, &c. and from which he can effect such a mixture of Ores and Coal as are best adapted for the production of metal; an advantage of which every smelter knows the value. Owing to this arrangement the manufacture of Welsh Iron is in the hands of a few extensive capitalists, and is carried on with great spirit and attention to improvement. The principal works are in the town of Merthyr, and its immediate vicinity; and, as the greatest proportion of the metal produced is manufactured into bar Iron, a process, which in the refining, puddling, and cementing of the metal, necessarily requires a great number

of furnaces; their appearance, in approaching to Merthyr, by night, from the hills with which it is surrounded, presents a scene which is probably without a parallel.

The following table exhibits the results of an examination of several varieties of Welsh Coal. The 1st column shews the proportion of volatile matter, including Gas, Bitumen or Coal Tar, and Ammoniacal Liquor, passing over in distillation. The 2d column, the quantity of Coke left by distillation, *minus* the proportion of earthy residuum, remaining after the combustion of the Coal in a strong red heat, which is shewn in the 3d. column.

Seams of Coal in the line of Section, *proceeding from north to south.*	Volatile Matter, ℔ cent.	Carbon ℔ cent	Incombustible Earthy Residuum, ℔ cent. leaving in combustion.	Specific gravity of Coal.	
Stone Coal.					
Seam on Mynydd Bach Llanedi, ...	8·65	89·85	Pale Yellow Ashes, ... 1·5	1·388	
Free-burning Coal.					
Clyngwernon Seam, ...	14·	79·0	Heavy Reddish Ashes, 7·0	1·388	
Penprys Seam, ...	14·5	82 0	White Ashes,..... ..... 3·5	1·304	
Bituminous Coal.					
Gelle Gile Seam, ...	16·8	80·6	Red Ashes..... 2·6	1·336	
Llwchor Colliery 5-Feet Seam, ...	19·	78·5	2·5	1·315	
Globrâisc Seam, Adair Colliery,.....	27·5	70·2	Yellow Ashes, ... 2·3	1·292	
Seams in different parts of the Coal Basin.					
Cox's Stone Coal Cwm Twrch,.....	7·5	91·5	Yellow Ashes..... 1·0	1·389	*f.*
Pool Coal W. of Llanelly, ...	19·8	77·8	Reddish Ashes, ... 2·4	1·285	
Bushy Seam Llanelly,.....	15·9	81·6	Ditto Ditto..... 2·5	1·303	
Great Seam at Merthyr, ...	13·4	85·6	White Ashes,..... 1·0	1·291	*g.*

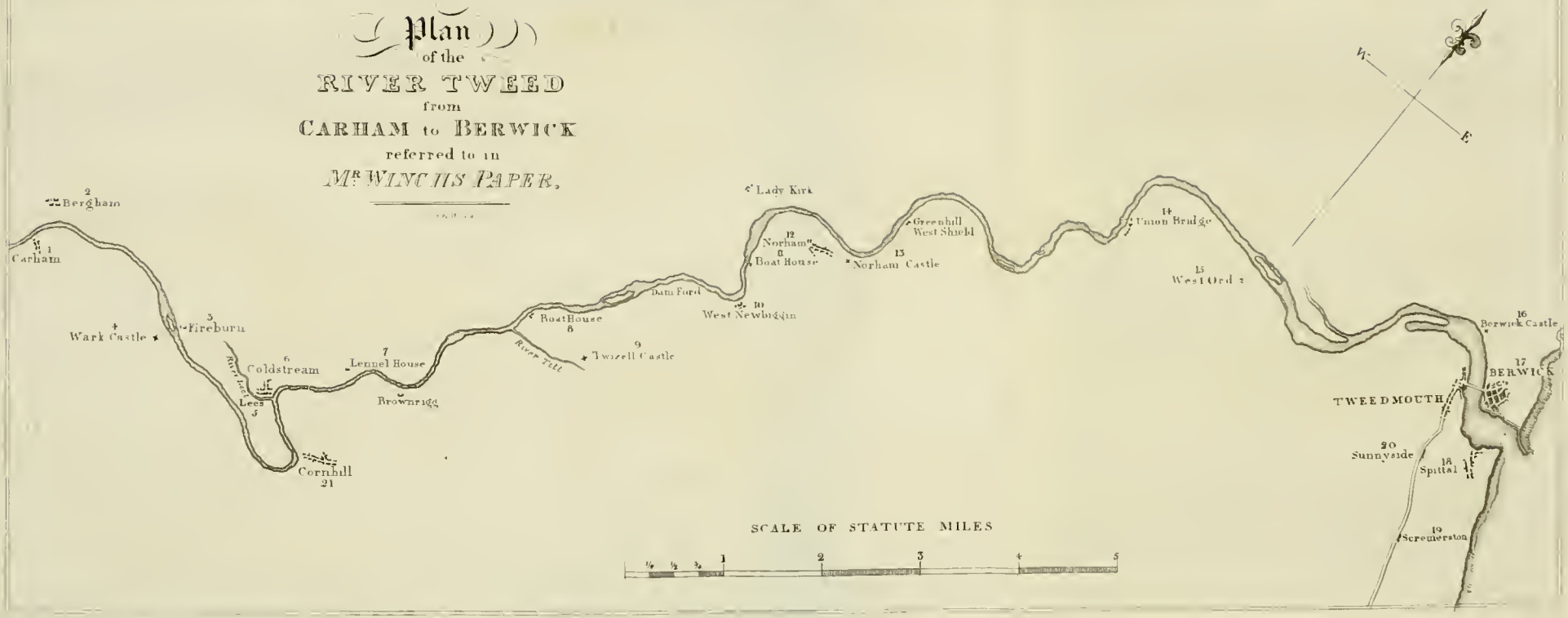
f. This Coal is very bright and pure, and more free from earthy matter than any Welsh Coal that I have seen, with the exception of the Great Seam at Merthyr. The Bushey Seam is Free-burning Coal, and barely comes within that class. The seams above it in the north-crop (*see* the diagram, page 104), are more decidedly Free-burning Coal.

g. This is the seam from which a great proportion of the Coke for the blast furnaces is procured. It is coked in heaps in the open air, and produces a close-grained Coke of a silvery lustre, and very free from Sulphur. It is a singular coincidence, especially when the difference in the quality of the Coals is considered, that the Coke left by this Coal when distilled in a retort, resembles the Garesfield Coke, one of the best on the river Tyne.

Newcastle, June 12, 1830.

PLATE XII

Plan of the RIVER TWEED from CARHAM to BERWICK referred to in MR WINCHS PAPER.



No. XV.—*Remarks on the Geology of the Banks of the Tweed, from Carham, in Northumberland, to the Sea Coast at Berwick.* *By* N. J. Winch.

Read July 20, 1830.

The rocky strata which border the Tweed from Carham Bourn, where the river begins to form the boundary between Northumberland and Scotland, to the sea shore at Berwick, appearing to be associated in a manner so different from the order generally considered by geologists as the natural arrangement, will oblige me to abstain from theory altogether in the following remarks. It is, therefore, my intention to lay before the Society merely a series of notes lately made during an examination of the north-eastern termination of our district, accompanied by specimens to assist in verifying the correctness of the observations.

A superficial view of the banks of this beautiful river presents a succession of eminences, I can scarcely call them hills, chiefly composed of Diluvium, containing numerous Basaltic boulders, water-worn, as usual. This soil is red; but colour does not always indicate the nature of the rocks below, for a red soil also covers the Porphyries and Syenites of the north of England and the south of Scotland. By a cut on the side of the road immediately beyond Coldstream Bridge, the incumbent mass of loose earth is shown to be not less than fifty feet thick, at that spot, from the top of the bank to the road, and for fifty feet more, to the brink of the stream, no rock is seen to crop out from under the debris; and subsequent remarks led me to think that this part of the country was generally clothed by a diluvial soil of considerable thickness. To avoid repetition, it may not be amiss to enumerate the rocks which are the subject of these notes. Excluding Basalt, they are all stratified, and, with few exceptions, dip towards the southward of east, but at very different

angles, some beds rather exceeding than falling short of 45°. The suite comprises Dolomite, indurated Marl, and Limestone containing Gypsum, Red and Variegated Sandstone, with nodules of Red Ochre, Bituminous Shales and Sandstones, with vegetable remains, Encrinal Limestone, also with vegetable exuviæ, Shale, with bivalve shells, and numerous beds of Coal; the whole series appearing to rest upon Transition Rocks, which, to the north-west and south-west form the Lammer Muir and Cheviot range of mountains.

At the distance of sixteen miles, in a direct line from the sea, and in the vicinity of Carham (*see* Map, No. 1.), a small burn enters the Tweed on its south side, dividing Northumberland from Roxburghshire. Here a bed of close-grained iron-grey Basalt occupies the bed of the river for a considerable distance, and near Carham Church rocks of pale-brown Dolomite may be seen on its banks. This Limestone seems to be superior to the Basalt, and is heaped together in irregular masses, but that these are a part of a regular stratum is evident, for at Haddon Rigs, a mile south from this place, the stone is quarried to the depth of ten feet for agricultural purposes, though, from the veins of reddish-brown Chert which pervade it, the produce of pure Lime is much diminished. Besides Chert, Calcareous Spar occurs in the rock, which, at the quarry just noticed, is about ten feet thick, with a covering of ten feet of soil. The next point where rocks are exposed to view is on the north side of the river; at the foot of Spring Hill, about a mile west of Birgham (*see* Map, No. 2.). Here numerous thin strata of soft arenaceous Limestone, of an ash colour, interstratified with greenish-grey indurated slaty Marl, mixed with Sand and Mica, form cliffs of nearly sixty feet high, and the river flows over strata of the same description. In this Limestone veins of flesh-coloured compact Gypsum* and nodules with crystals of brownish-red Selenite are tolerably abundant. The rocks lie very regular, and dip, at a trifling angle, to the south-east. The relation they bear to the Red and Variegated Sandstones will be noticed when the strata situated lower down the Tweed come under consideration.

* Gypsum is also found at Fluers, some miles higher up the Tweed, on its north bank, and by the Rev. A. Baird, on the banks of the Whiteadder, near Hutton Hall.—*Geological Essay on Berwickshire, in the Preface of* Johnston's *Flora of Berwick, page* xxi.

In the bed of the rivulet called Firebourn (*see* Map, No. 3.), a slip or dyke is worthy of notice; in the language of miners, it casts up to the east, and the thin strata of Limestone and indurated Marl, before mentioned, may be seen in the water-course, dipping at an angle of 40° in that direction. On the banks of the river, at a trifling distance lower down, another slip divides the rocks, and brings two beds of micaceous Sandstone into contact with the calcareous series; the upper of these Sandstone beds is slightly tinged red, owing to its Mica being oxidated, but the lower is of a pale yellowish-brown colour, and ambiguous character, rather resembling a Coal Sandstone; their aggregate thickness, with a thin micaceous parting, is fourteen feet. Half a mile below Firebourn there is a ford across the Tweed, noted in border history; its direction is south east, and may have been occasioned by the dyke. On the south side of the river the ruins of Wark Castle (*see* Map, No. 4.) stand on an eminence sixty feet high, composed of calcareous strata, similar in every respect to those at Spring Hill, but their dip is in an opposite direction. These impure Limestones seldom exceed a foot in thickness, and Gypsum is interspersed through them. At about a hundred yards west of the Castle, rocks of Dolomite again crop out on the banks of the river, but to the eastward this peculiar mineral was no more to be seen; nor could I thoroughly satisfy myself as to its geological position, though I have every reason to believe that it rests upon the Basalt, and suspect this rock belongs to the same bed as occupies the north shore of the Tweed at Carham, and is here again brought to the surface by the Firebourn Dyke.

Again, passing to the north side of the Tweed, near the Temple at the Lees (*see* Map, No. 5.), eight alternations of the same calcareous beds as form the cliffs at Spring Hill and Wark, (except that the lower stratum of Limestone contains very minute bivalve shells filled with Calcareous Spar,) occupy the bank and the bottom of the river; their thickness above ground is about ten feet, and their dip towards the north-west. No strata of this description were again noticed for nearly six miles, and when again seen, were found associated with Red Sandstone, in the vicinity of Norham.

The town of Coldstream (*see* Map, No. 6.) stands on what are usually called Coal Measures, comprising Sandstones and bituminous Shales, exactly the same as those of the Newcastle Coal-field, and wherever Diluvium does not form the shores of the river, these may be traced for the distance of two miles and a half. The little river Leat, which here empties itself into the Tweed, passes through Mill Haugh, where the late Lord Home bored for Coal, but to what depth I could not ascertain. An extensive Free-stone quarry is worked in this field to the depth of thirty feet; the upper and middle beds are white Micaceous Sandstone, fine-grained, and full of Coal pipes, the lower is free from these vegetable exuviæ.* A strong chalybeate spring rises to the day, and runs into the Leat at a short distance from the quarry. Both above and below Coldstream Bridge the Tweed flows over these Coal Measures, which dip, at a trifling angle, to the south-east, and the rocks on the south side having been cut through, Micaceous Sandstone, alternating with Bituminous Shale, and covered with a bank of red earth, are laid open to view, and beds of the same nature may be noticed half a mile lower down the stream. But the cliff at Lennel Braes (*see* Map, No. 7.), on the north side, two miles to the eastward, exhibits the most perfect section of this suite of strata to be met with in the vicinity. At the Braes the perpendicular cliff extends for more than a hundred yards, and was estimated by me at forty feet in height, exclusive of its diluvial covering, but the correct section, published in Mr. Witham's pamphlet *On the vegetable Fossils* found there, makes its elevation forty-four feet. The uppermost bed is Sandstone, which is succeeded by four others, alternating with slaty Sandstones, or Coal Metals and Shales enclosing balls of Clay Iron-stone. Their dip is north-east, and the rocks on the south side of the river appear to resemble them. The petrified trunks of trees are irregularly dispersed through the lower bed of Shale, and are both of the Monocotyledonous and Dicotyledonous classes of

* Sandstones, bearing strong indications of being associated with beds of Coal, are quarried at Sprouston, in Roxburghshire, for an account of which see Mr. Buddle's pamphlet "*On the search for Coal in a part of the counties of Roxburgh and Berwickshires, in* 1806," pp. 10, 11. These Sandstones are very hard, and filled with Coal pipes.

vegetables, but for an accurate description of these interesting Fossils the pamphlet before mentioned must be referred to. At no great distance east of this escarpment a quarry has been opened on the side of the bank to the depth of twenty feet, and is situated more than twenty feet above the river. The stone here has a slight tinge of red, similar to the stratum in the upper part of the cliff at Firebourn, which abuts against the calcareous beds. It dips to the southward, and is divided by thin slaty micaceous partings, and capped by about ten feet of loose Sand, the abode of flights of Sand Martins. On the north side of the Tweed, at the distance of a mile above Twizell Ferry, rocks of well-defined Red Sandstone make their appearance. It is fine-grained in texture, of a dark reddish-brown colour, and abounds with spangles of silvery Mica. The cliff is of considerable elevation, and from hence to the sea coast, thick beds of Red and Variegated Sandstone, at some places covered by the thin calcareous strata previously mentioned, and at others interstratified with them, become prevalent, though Coal Measures may be noticed in their vicinity (*see* Map, No. 8). On descending the river until opposite Twizell Boat House, fine-grained micaceous Red Sandstone rocks, and those of the Coal formation, or at least such as have heretofore been considered exclusively as such, are in close contact. On the north shore, low rocks of the latter description appear *in situ*, and, it may be worth remarking, that, on ascending the river Till, for the distance of a mile westward, Twizell Castle (*see* Map, No. 9.) may be seen, built on an extremely hard grey micaceous Sandstone, filled with *Coal Scars*,* and so promising did this neighbourhood appear, as to induce the proprietor to make a trial for Coal. Three-quarters of a mile further up the Till, the red rocks are again met with, and worked at Mill Quarry, but at Dunstan Haugh, two miles and a half from the castle, the stratum quarried is yellowish-white, and seemed to

* Minute fragments of red Garnets are embedded in this Sandstone ; a circumstance I have never noticed in the Sandstones of the Newcastle Coal-field, but in the Millstone grit at Shaftoe Crags, near Wallington, the same mineral was detected by W. C. Trevelyan, Esq., and it abounds in the Grauwacke of Bournmouth, north of Berwick. The Twizell Sandstone I suspect to be an old member of the Carboniferous Limestone formation.

be a Coal Sandstone. But to return to Tweed side. On the south bank, above the Ferry House, there is a perpendicular cliff, forty feet high, of white Sandstones, though tinged red on their surfaces by the oxidation of their Mica; the beds are separated by thin micaceous partings, and in every respect resemble the rock quarried below Lennel. On the north side, just below the ferry, the cliff is not less than fifty feet above the stream, and composed of fine-grained Red Sandstone, with small scales of silvery Mica. On descending the river, the rocks on the south shore continue red, micaceous partings divide the thick strata, through which nodules of Red Ochre are dispersed in abundance, and those on the north side agree with them in every character.

Opposite Newbiggin (*see* Map, No. 10.), the elevated cliffs are rendered singular by an escarpment of bright red Marl, which, from a distance, is a striking object. The dip is towards the south-east. Near Norham Boat House (*see* Map, No. 11.), the Tweed sweeps round the foot of a promontory of not less than seventy to eighty feet in height; its rocks are red, and differ in no respect from those a little higher up on the north bank of the river. To the eastward (*see* Map Nos. 12 and 13.), Norham Castle stands upon an eminence overlooking the Tweed, and, as the stones of which it is constructed are red and white, the vicinity of quarries of both these kind of rock is evident, but the geology of its immediate neighbourhood may be studied to most advantage by carefully inspecting the abrupt cliffs below the castle mount. A beautiful and interesting section is there developed. The lowest bed, which is scarcely above the level of the stream, consists of a whitish Sandstone and Limestone forming a Breccia; on this rests a stratum of reddish Sandstone, forty feet thick, which is, in turn, capped by fourteen thin seams of soft ash-coloured Limestone, interstratified with an equal number of others of greenish-grey slaty Marl, mixed with sand and silvery Mica; their aggregate thickness is twenty-five feet, which, with five feet of Diluvium, will give seventy feet as the elevation of the escarpment. When viewed from below, the upper part of this singular cliff appears to be striped with the regularity of a ribbon. In the thick bed of Sandstone, pear-shaped nodules of extremely hard white

micaceous Sandstone abound, and greatly impede the work of the quarry-men; some of these nodules are not many inches in diameter, but I measured one of two and a half feet; they are not ranged in lines, but their sharper extremities point towards the north-west, which is the full rise of the stratum containing them. Proceeding eastward to the vicinity of Horncliffe House, the rocks are still Red Sandstone, with similar calcareous seams as those near Norham resting upon them, and a cut, made to widen the road to the Chain Bridge (*see* Map, No. 14.), lays open thirty feet of rock, comprising six different strata; the lowest is Red Sandstone, the others Limestone and slaty indurated Marl. A slip of six feet cuts through these beds. Above West Ord (*see* Map, No. 15.), a cliff of sixty feet again exhibits the nature of the rocks; here the Variegated Sandstone rests upon the red, which is filled with nodules of Red Ochre, and is covered by the calcareous series so frequently mentioned; and at the plantations, a little lower down the river, six alternations of these thin beds are covered by thick strata of Red and Variegated Sandstone. At Ord Mill, the red rock alone is visible; the dip of the whole series is southward of east. Diluvium now covers the rocks on the south shore of the Tweed the whole way to the harbour, but on the north bank, Berwick Castle (*see* Map, No. 16.) stands upon an elevation about ninety feet high. Under the soil the rocks are Variegated and Red Sandstones, of extremely fine-grained texture; the beds are thick, in which they may be compared to the *posts* in this part of our district, while the thin calcareous strata occupy the place of our *Metals* and bituminous Shales; but so considerable a proportion of Carbonate of Lime do all the Sandstones hereabout contain, that they effervesce on the application of diluted mineral acids. The dip southward of east. From the rocks on which Berwick Castle is constructed, to the entrance of the harbour (*see* Map, No. 17.), the space is covered by soil; but both towards the north and south high and rugged cliffs bound the ocean. Those to the north shall first be brought under consideration. On passing through the Sally-port, and before reaching the Pier, the following succession of rocks rise to the day:—1st, a thick stratum of fine-grained brick-red micaceous Sandstone; 2d, hair-brown Limestone, with small Encrinites; 3d,

slaty micaceous Sandstone, of an ash-grey colour; 4th, Red Sandstone, 5th, Encrinal Limestone; 6th, white Sandstone, blotched by Red Ochre and containing Coal pipes; 7th, Encrinal Limestone; 8th, slaty micaceous Sandstone; 9th, Encrinal Limestone; 10th, Variegated Sandstone. These strata occupy the space from the Sally-port to the Pier. The Limestones are of inconsiderable thickness, and envelope bivalve shells as well as encrinites. The Red and Variegated Sandstones are very fine-grained, with but little Mica, and the Coal Sandstones white, when not tinged by Yellow Ochre. At this point, which may be about a hundred yards north of the Pier, a slip dyke, of considerable magnitude, intersects the cliff, and may be traced eastward into the sea; its breadth is three yards, the south side of the chasm being filled for two yards by Shale, and the north side by a rib of brownish-purple Limestone, so hard as to give fire with steel; it is of a fine texture, with a splintery fracture, and impressions of the lanceolate leaves of some species of *Variolaria*, of A. Brongniart, *Stigmaria*, of Sternberg, are dispersed through it. The hade of the dyke is inconsiderable, but to the south of it the strata dip to the south-east at an angle of 45°. A little to the north the rocks become less inclined, and dip to the east at a trifling angle; the upper is a stratum of ash-coloured Shale, twelve feet thick, filled with Producti—(*Productus scoticus*, Sowerby, *Mineral Conch.*, t. 59, f. 3; and *Productus antiquatus*, t. 317, f. 1, 5, 6.)—the shells of which retain their pearly lustre; the lower stratum is Encrinal Limestone, enclosing specimens of very large Producti—(*Productus giganteus*, Sowerby's *Mineral Conch.*, t. 320.)—being the same Fossil which gives the name of Cockle-shell Limestone to one of the beds in the neighbourhood of Alston. On the beach the Limestone is laid bare by the action of the waves, and exhibits the extraordinary undulations long since noticed in the stratification at Holy Island. Probably the stratum may be the same; but it is not safe to hazard conjectures on the identity of mineral beds on a coast where their dips are so various, and positions unconformable.

On the south side of the harbour, at the distance of half a mile from the bridge, the strata incline to the south-east at an angle of 45°, and are

arranged in the following order :—1st fine-grained pale Red Sandstone ; 2nd, a thin stratum of slaty micaceous Sandstone ; 3d, twenty-five feet of dark red micaceous Sandstone ; 4th, Shale, with thin strata of Encrinal Limestone ; 5th, Red Sandstone, divided by the same Limestone, —the total thickness of these beds is one hundred and twenty feet. Below Spital Mill, (*see* Map, No. 18.) half a mile further south, a thick stratum of Sandstone, of peculiar appearance crops out ; it is yellow, blotched with red, and is very friable, its grains scarcely adhering ; and on the beach, about twenty yards north of this spot, the Limestone is separated by a parting of ash-coloured Shale, containing bivalve shells, (*Corbula limosa*, Fleming's *British Animals*, 426,) in abundance. Near Spital farm, a dark gray compact Limestone, containing vegetable exuviæ, similar to those noticed in the Limestone in the Dyke on the north side of the harbour, rises to the day about high water mark, and may be considered another of the anomalous rocks of this coast. At the foot of the railroad, situated a little further south, Coal Sandstone, enclosing casts of large vegetables, (*Stigmaria ficoides*, Sternberg, t. 12, f. 1, 2, 3 ; and *Lepedodendron obovatum*, t. 6, f. 1.) and bituminous Shale alternate, beyond which a quarry has been worked in the red rock to the depth of forty feet. The stone it affords is hard and fine grained, and has been used in constructing the new pier. Proceeding southward to Huds-head, the red rock, of which the cliff here consists, abuts against the Coal Sandstone, which is close behind it, and within two hundred yards, one of the Scremerstone shafts (*see* Map, No. 19.) is sunk. At North Scremerstone, two miles from Berwick Bridge, the rocks are Red Sandstone, Shale, and Encrinal Limestone, the latter of which has formerly been quarried, and a little to the south, an extensive quarry is now open at a place called the Red Houses. The stratum is 18 feet thick, and affords a blueish-grey stone, close in its texture, and containing Encrinites. It dips at an angle of 45°, and undulates in the same way as the Limestone upon the beach on the north side the harbour. Proceeding inland to Sunnyside Hill (*see* Map, No. 20.) where workmen are now employed in widening the great south road to Berwick, two excavations are made in the solid strata. At the northern cut, which is

now twenty-two feet deep, the lowest rock is dark grey Encrinal Limestone, covered by beds of Coal Measures of inconsiderable thickness, but interstratified with four thin seams of Coal. The southern cut, which is nearer the summit of the hill, is at present fourteen feet deep, the lowest rock is a thin Limestone bed; 2nd, a thin seam of Coal with a band of Shale; 3d, Limestone; 4th, Coal and Shale; 5th, Red Sandstone; 6th, Coal and Shale. The dip is, as usual in this vicinity, to the east. Sunnyside Hill, is a mile south of Berwick. Near the coast, I observed no Basalt *in situ*, and the only well-defined dyke of that description met with, was at Ousenton Bourn, a mile and a half east of Cornhill (*see* Map, No. 21.); the rib of Basalt is 18 feet wide, and crosses the bourn from west to east. The blocks lie in a horizontal position, and the stone is dark grey, approaching to black, with large greenish crystals of glassy Felspar.

In Mr. Smith's present *Geological Map of Northumberland*, which differs essentially, in that portion of the north of England, from his large map, the red tint, indicative of the New Red Sandstone, ceases about three miles from the coast, but it is not possible to trace the slightest distinction between the red rocks at West Ord or Berwick Castle, and those connected with the Coal and Encrinal Limestone at Scremerstone.* From the enumeration of the rocks which occur at West

* To my friend Mr. Fenwick, of Dipton, who has ever kindly furnished me with mining information of a similar description, I am indebted for the section of strata at Scremerstone, and the account of the Seams of Coal worked in the Berwick district. In a geological point of view, documents of this nature are invaluable.

An Account of the Strata from the Surface to the Main Coal Seam in the Engine Pit at Scremerstone Colliery.

	FA.	FT.	IN.	FA.	FT.	IN.
Sunk through Clay and Broken Stone, ...	3	1	0			
Box further, (in the same Clay, &c.).		4				
Blue Metal,...		1	3½			
Hard Band, ...			6			
Grey Band, ...	1	1				
A hard Band, ...			4			
Coal, 1.			6			
				5	2	7½
Carried forward				5	2	7½

Ord, Berwick Castle, the sea-coast, both on the north and south of the harbour, on the hill at Sunniside, and the shaft of Scremerstone Col-

	FA.	FT.	IN.	FA.	FT.	IN.
Brought forward				5	2	7½
Grey Bands and Metal, ...	2	1	8			
Red Sandstone, ...	3	4	2			
White Sandstone, ...	3	1	5			
Coal, 2.			6			
				9	1	9
Blue Metal, ...		2	3			
Grey Stone, ...		4	3			
Thill or Metal Stone, ...		1				
Coal, 3.		1				
				1	2	6
Blue Metal, ...		3				
Grey Stone, ...			6			
Blue Metal Stone, ...		3				
Red Sandstone, ...	1	5	6½			
White Post Stone, ...		3	4			
Metal, ...		4	8			
Grey Stone, ...	1		7			
Grey Bands, ...		1				
Metal, ...	1	3	2½			
Grey Stone, ...		1	7			
Coal, 4.			4			
				7	2	9
Grey Stone, ...		4	8			
Hard Band, ...			5			
Blue Metal, ...		1	4			
Coal, 5.		1	2			
				1	1	7
Bandy Metal, ...		5	10			
A hard Band, ...			6			
Metal, ...		3	7			
White Stone, ...		4	11			
Metal, ...		1	6			
White Stone, ...	1		10			
Metal, ...		2	10			
Grey Band, ...			2			
Metal, ...		3	3			
Coal, 6.		1	8			
				5	1	1
Metal, ...		2	3			
White Stone, ...	1	1	2½			
Metal, ...			6			
White Stone, ...	2	1	5			
Metal, ...		1	3			
Grey Stone, ...		2	9			
	4	3	4½			
Carried forward				30	0	3½

liery, there can be no doubt but that the Red and Variegated Sandstones on Tweedside, notwithstanding the presence of Gypsum and Selenite, in the beds at Carham, Wark Castle, and on the Whiteadder, are coeval with the Encrinal Limestones, and we may safely refer the red bed formerly quarried at Lindesfern, and that accompanied by Coal

	FA.	FT	IN.	FA.	FT.	IN.
Brought forward	4	3	4½	30	0	3½
Metal, ...		4	6			
Coal, 7.			6			
				5	2	4½
Metal, ...		1				
Limestone, ...		2				
Coarse Coal, 8.		1	6			
Grey Metal Stone, ...			6			
Coarse Coal, 9.			10			
Stone, ...			2½			
Rough Stone, ...			10½			
Coal, 10. Main Coal, Scremerstone, ...		4	3			
				1	5	2
Boring from the Main Coal Seam, towards the Cancer Coal				37	1	10
Blue Metal, ...	1	5	5			
Girdle, ...			5			
Blue Metal, ...		3	4			
Girdle, ...			6			
Blue Metal parting, ...			3			
Post Girdle, ...			11			
Coal, ...		2	3			
Band, ...			6			
Coal, ...			10			
				3	2	5
Blue Metal, ...		1	6			
Girdle, ...			4			
Parting, ...			1			
Girdle, ...			5			
Brown Metal		2	9			
Coal, ...			5			
					5	6
Brown Metal, ...		1	5			
Coal, ...			7			
Brown Metal, ...		1	9			
White Freestone, ...	1	1				
Red Freestone, ...	1	1				
White Freestone, ...	11		5			
Parting, ...			3			
	14	0	5			
Carried forward.				41	3	9

and blue Limestone in the vicinity of Edinburgh* to the same series of rocks. In the Newcastle coal-field, where no Limestone is interstratified with the measures, Red Sandstone differing in no respect from those just mentioned may be noticed near the sea coast of Northumberland at Cresswell, Ellingham, Woodhorn, Newbiggin, Tynemouth; also at Burrowdon, in the neighbourhood of Gosforth.

As investigation advances, the lines of demarcation between different

	FA.	FT.	IN.	FA.	FT.	IN.
Brought forward	14		5	41	3	9
White Freestone, ...		1				
Coal, the Seam probably may be the Cancer Coal		2				
				14	3	5
Grey Metal, ...			6			
Limestone, ...		3	6			
Grey Metal, ...		4	8			
Coal, ...			6			
				1	3	2
Grey Metal, ...		1	4			
White Freestone, ...		3	9			
Limestone, ...			6			
White Freestone, ...		4	5			
Limestone, ...		3	2			
				2	1	2
				59	5	6

OBSERVATIONS ON THE SEAMS OF COAL IN THE BERWICK DISTRICT.

The seams of Coal near the sea coast in this district, generally dip nearly due east, at an inclination of one yard in three; to the westward, their dip is to the southward of the east, with an inclination of one yard in ten or twelve.

1st. The Muckle Howgate Seam is the first workable bed on the Scremerstone estate, and in its vicinity; it lies at various depths below the surface, and is about two feet six inches in thickness; it is considered an inferior Coal in quality, and used only for burning Limestone.

2nd. The Caldside Seam, supposed to be about sixty fathoms below the Muckle Howgate Seam, is generally used for the same purpose, though rather of a better quality than No. 1.

3d. The Scremerstone Main Coal, supposed to be about sixty fathoms below the Caldside Seam, is four feet in thickness, but with a thin band of stone near its bottom. This seam is reputed the best coal for house use, except the portion nearest the bottom, which is sold for Lime burning.

4th. The Stony Coal lies from two to three fathoms under the Scremerstone Main Coal

* Mr. Dunn's MS. Section of Gilmerton Colliery.

formations, seem to vanish, and doubts are left upon the mind even whether distinct epochs have at any period intervened between the commencement and termination of the consolidation of secondary strata. The mineralogical characters of rocks are now acknowledged to be no satisfactory evidence of geological position, for by hand specimens, who can point out the difference between the Red Sandstones, associated with Coal and Encrinal Limestone at Berwick, or with Magnesian Limestone in the county of Durham. If the mode of concretion is called to our aid, we find the oolitic form is assumed, not only by the Limestone usually denominated Oolite, but by the Magnesian Limestone at Hartlepool, (*Geological Transactions*, vol. iv. p. 7,) and by the Encrinal Limestone at Warcop in Westmoreland, as noticed by Mr. Fryer many years since. Dolomite is interstratified with the Carboniferous or Encrinal Limestone in Derbyshire, as is Chert, in the Lead measures at Ark-

its thickness is about four feet, including a band of Stone of twelve inches in its middle. This Seam of Coal is not reputed so good as No. 3. It has been worked, but to no considerable extent, near Berwick.

5th. The Cancer Coal is supposed to be from twelve to fifteen fathoms below the Stone Coal, but the distance between them varies. The seam has not been worked in the eastern part of the district, lying at a considerable depth in that situation; but at Thornton, Shoreswood, Gatherick, and some adjoining places in the western part of the district, it is worked under the name of the Main Coal. Its thickness is from five to five and a half feet, and its quality is not good, the bed being traversed by thin bands of stone.

6th. The Three-quarter Coal lies at variable distances below the Cancer Coal, being in some places found at twelve, and at others twenty-two, fathoms deeper than that seam. Its usual thickness is two feet eight inches, including a band of stone of ten inches; its quality is inferior to the better coals of the district.

7th. The Cowper Eye Seam is generally met with about four fathoms below the Three-quarter Coal; it varies in thickness from two to three feet of saleable Coal, having a stone band in its middle, unequal in thickness, but in some situations exceeding two feet. This seam is chiefly worked in the western part of the district, as at Murton, Thornton, Shoreswood, Felkington, Etal, Gatherick, Greenowalls, and their vicinity. In quality, it is considered equal to No. 3, Scremerstone Main Coal.

No. 8. The Western Coal Seam appears to me to be the lowest worked in the district. It has been sunk to at Shoreswood, and there found at about fourteen fathoms below the Cowper Eye Seam, but the quality being indifferent, it was not thought worth working. At Etal there is a mine carried on in it, though even there the coal is of inferior quality.

From the gradual rise of the strata to the westward, the first four seams mentioned in the section of the strata near Berwick, do not reach to Thornton, Shoreswood, Felkington, Etal, Gatherick, and Greenowalls. Nos. 5, 6, 7, and 8, are the beds worked at those Coal Mines.

engarthdale, in Yorkshire, (*Geol. Trans.* vol. iv. p. 63,) but neither of these remarkable strata occur in the Lead mine district of Durham or Northumberland, though a part of the same chain of hills; nor can the identity of Millstone Grit be here depended upon as in Derbyshire, for one bed at least of this apparently well-defined rock, is associated with Coal measures at Hauxley, Widdrington, Ulgham, Berwick Hill near Mason Dinnington, and Heddon-on-the-Wall, and another traverses the country to the westward, from the sea coast in the vicinity of Howick and Warkworth by the Helm on the Hill, Netherwitton, Roadley, Shaftoe Crags near Wallington, and Stamfordham. Basalt being evidently the production of fire, and pervading in an irregular manner rocks of almost every age, does not come within the scope of these remarks; so that the similarity of organic remains has at length become the Geologist's chief guide and reliance, in proving or endeavouring to prove, the identity of formations, but if I mistake not, these exuviæ will not always warrant the conclusions drawn from their presence.

No. XVI.—*Sketch of the Life and Works of the late Thomas Bewick. By* Mr. George C. Atkinson.

Read June 15, 1830.

The invention of Wood Engraving, forms an epoch of the most interesting description in the history of the Fine Arts. William Pluydendorf and Michael Wolgemuth engraved blocks for the *Nuremburg Chronicle*, folio edition, 1493, and are the first artists on wood whose names are preserved. Their productions, though possessed of considerable spirit, are stiff and inaccurate in representation.

It is to Albert Durer, however, that we are indebted for the most finished and beautiful wood engravings of that early period. Though born in 1471, and possessed of an imagination most fertile, it was not till three or four years after the publication of the *Nuremburgh Chronicle*, that he exhibited to the public any specimens of his talent. The impressions taken from his blocks are not uncommon, and are exceedingly spirited, but rather deficient in grace.

Hans Holbein followed, and in 1530 published his *Dance of Death*, consisting of fifty-three small cuts. He produced other engravings both before and after, but this is the most celebrated of his efforts in that way.

One great characteristic of the wood engravings of the old masters is the frequent introduction of "cross-hatchings;" an operation of most difficult execution in the present mode of wood engraving, where each square cavity must be cut out with a tool, to leave prominences, the impressions from which would exhibit the crossing of parallel lines.*

Bewick thought that these cavities were produced by means of a

* A wood block to give such an impression would resemble, in its indentations, the impresssion of a wafer stamp upon wax.

THOMAS BEWICK

Drawn & Engraved by Edward Train

From a Bust by Bailey

square pointed punch, and the only reasonable objection to this ingenious idea, seems to be, the difficulty (without a complicated apparatus) of ensuring the requisite uniformity on each application of the punch. I should be rather inclined to think that this effect was produced by some chemical process on the principle of etching, a solution of some unctuous substance capable of resisting the acid, being employed; this, of course, would protect the block wherever it was laid on, and leave a projection to receive the ink. In fact, the practicability of this method has been proved by Mr. D. Somerville, who introduced the hatching with great freedom and delicacy. It was intended by that gentleman, I believe, to make his discoveries the subject of publication; and surely those persons, who in the smallest degree assist in lifting the veil which once so closely enveloped our scientific knowledge, and which we (as well as our fathers) imagine must be now almost entirely withdrawn, deserve the warmest gratitude of mankind.*

After the time of Durer and Holbein, the art seems to have taken a refreshing nap of a century or two, for we find no improvement in the executive part till late in the eighteenth century, when a boy named Bewick rambled alone into the old lady's chamber, and, seizing her resolutely by the shoulder, gave her such a shaking, and kept her in such high good humour with the entertaining and instructive stories he told, all the time making her participate in them, that I question if she will ever retire again, particularly as she has made such favourites of some of the present generation.

The works of Bewick are very numerous; more so, I believe, than those of any other engraver, either on copper or wood. They consist chiefly of subjects, done on wood to illustrate his *History of Quadrupeds, and of British Birds;* of original designs for the *Fables of Æsop and others*, and of humourous vignettes or tail pieces, interspersed throughout these works. *A History of Fishes* was the next subject which engaged his attention; in this, however, he had only advanced

* Since writing the above, I have been informed that the hatching introduced with such beautiful freedom in Mr. Harvey's wood cut of the *Death of Dentatus*, was entirely produced by the usual method of cutting.

as far as fourteen or fifteen illustrative cuts, at his death; and, as a completely new set of appropriate tail pieces, were almost finished for the embellishment of this undertaking, it is most desirable that the principal subjects should be continued by some one adequate to the task, that the world may not be deprived of any of the productions of so celebrated a master. His only son, Mr. Robert E. Bewick, is proceeding in the completion of this desirable undertaking, for which, from his curious fidelity of representation, he is admirably calculated.

The engravings of Bewick are characterised by great boldness and freedom, combined with the opposite excellences of delicacy of execution and scrupulous fidelity; but he added to them, from his early and unceasing observation of nature, a knowledge of the manners of her animated productions, from man downwards, which imparts the chief, though to many unaccountable, charm of his designs. This quality is manifest in them all, and is quite unequalled by any other master.

With such qualifications for the execution of the works above mentioned, it may readily be inferred that he was eminently successful. In fact, to naturalists they are invaluable, as the most faithful representations of two branches of the animal creation; and, to lovers of the fine arts, they present specimens of the long-lost art of Wood Engraving, which, combining excellency of design and execution, can never be surpassed.

In improving the taste of the day, there is no doubt they have been eminently instrumental. This is readily perceivable in the repeated copies of all kinds which have been made from his cuts, and have not only found their way into the artist's port-folio, and the multitudinous editions of children's books which have been published, but have been adopted to ornament the most ordinary domestic utensils, plates and dishes.

The benefit they are of, as interesting and instructive books for children, is not the slightest they confer. How much more noble and reasonable it is that a child should derive its first ideas from representations of the works of our Creator, than that the young mind should be overcharged with frightfully distorted images of humanity, endowed often

with preternatural attributes, and acting according to the rank fancy of the author, rather than to any reasonable or moral and exemplary motive.

In our museums, too, we owe the present improvement on the grotesque figures which satisfied and misled former naturalists, entirely to his faithful and simple representations.

As a debt of gratitude, therefore, to this celebrated man, it seems only reasonable that the first volume of the Transactions of a Society devoted to the cultivation of Natural History (existing in the town, to which he was so bright an ornament, and to many of the inhabitants of which he was intimately known), should contain a notice of his life and works.

Having, for the last few years of his life, enjoyed a closer intimacy with him than any other person, not attached to him by relationship, I am induced (from the idea that it will be gratifying to those who knew him, to peruse this memorial), to present it for publication to the Natural History Society.

Thomas Bewick

Was born at Cherry Burn in the Parish of Ovingham, in Northumberland, on the 10th, or 11th of August, 1753; he always kept his birthday on the 12th, but had reason to believe it occurred on one of the two previous days. His grandfather, Thomas Bewick, of Birches Nook, near Bywell, married Agnes, daughter of —— Arthur, of Kirkheaton. After giving him five children she died, and was buried at Ovingham, in 1756; he was buried at Bywell. John was their fourth, and only male child; he lived at Cherry Burn, and rented a land-sale colliery at Mickley; he had two wives; the first, Ann Topping, died childless, and was buried at Ovingham; the other, Jane, daughter of Thomas Wilson, of Ainstable, in Cumberland, had eight children, of whom Thomas, the subject of this memoir, was the oldest. John Bewick, an eminent engraver in his day, was the fifth; he died, unmarried, on the 5th December, 1795.

From the Parish Register at Ovingham, I find that "Thomas, son of

John and Jane Bewick, of Cherry Burn," was baptized on the 19th of August, 1753. He was sent to school at an early age, as a day scholar, to the Rev. Christopher Gregson, at Ovingham, the predecessor to the present worthy incumbent Mr. Birkett, to whose early instructions many of the young men of the northern counties (myself, I am proud to say, among the number) are so deeply indebted. Such a feeling it was which pervaded the bosom of Mr. Bewick towards his early preceptor, and led him not only to speak of him at all times in terms of the sincerest gratitude and respect, but, at a later period to engrave a profile shade of him for the illustration of a memoir of himself, intended to contain likenesses of his friends.

In the interval of his studies at Ovingham, his time was a good deal occupied in assisting his father at Mickley: he still, however, found leisure to execute several drawings, in a manner sufficiently spirited to attract the attention of his parents, and induce them to bind him at the age of 14 to Mr. Beilby, of Newcastle, as an engraver. This circumstance, eventually so interesting, took place on the 1st October, 1767.

During his servitude he paid weekly visits to Cherry Burn, except when the river was so much swollen as to prevent his passage of it at Eltringham, when he contented himself by vociferating his inquiries across the stream, and then returned to Newcastle.

The first wood cut he did, was the representation of a *George and Dragon*, for the bar bill of a public house: the second was of a similar nature for the Cock Inn, then one of the best in town, at the Head of the Side; these were executed in the early part of his apprenticeship, and though considered wonderful productions at that time, they are rude and unfinished when compared with his later efforts. While with Beilby he was ofen employed in engraving clock faces, which I have heard him say, made his hands as hard as a blacksmith's, and almost disgusted him with engraving: he also cut an immense number of steel watch seals.

About this time his master was engaged in cutting the diagrams for *Hutton's Mensuration* (4to. ed. Newcastle, 1770), and was assisted in it by young Bewick, who blocked them out for him; but by a simple

and ingenious contrivance, he so far surpassed his master, that the concluding figures were, at Mr. Hutton's desire, executed by him alone. It is scarcely necessary to remark, that in wood engraving, where the prominent parts of the block, and not the cavities, as in copper, receive the ink, it would be matter of some difficulty, with only a tool like a small chisel, to cut the block, so as to give impressions of curved lines, equally thick and regular throughout! Bewick saw this, and after a little consideration, thought of making a chisel with two points, which being immoveable, would not fail to produce a line of equal thickness. There was another difficulty; no one could make him a tool sufficiently fine: here, however, his ingenuity again befriended him, for he covered the steel with a coat of etching ground, and by the application of an acid, easily procured a cavity of the requisite form, and found the tool answer every expectation. From this time, he devoted himself more exclusively to wood engraving; his success in cutting the figures for Mr. Hutton, and their easiness of execution, when compared to the heavy laborious work he had been before engaged in, on metals, gave a bias to his inclinations, which ultimately led him almost entirely to relinquish the other branches of the art, in favour of wood engraving.

On the expiration of his seven years, he returned to Cherry Burn, and did job work for Mr. Beilby, coming into Newcastle once or twice a week.

The first book, containing specimens of his art, is "*Youth's Instructive and Entertaining Story Teller,*" 12mo.; the first of which was published by Saint, at Newcastle, in 1774, and the second in 1775.

About this period, he determined to go to London, and on the 1st October, 1776, he arrived for the first time in that overgrown place; he staid there about a year and a half, working with a person of the name of Cole. While there, he cut a beautiful wreath of flowers for his friend Mr. Thomas Angus, printer, who had it worked off as a tail piece in the *Freemason's Companion,* published at Newcastle in 1777.

In 1779, Saint published "*Fables by the late Mr. Gay, in* 1 *vol. complete.*" This book was illustrated by Bewick's wood cuts, and contained the five prints which gained him the medal of the Society of

Arts. The advertisement for the publication of this, announces, "a new and elegant edition of Gay's Fables, in 8vo., on fine writing fools-cap, adorned with *very curious cuts*, and a finely engraved frontispiece; some of these cuts have gained the premium of the Royal Society, price 3s. neatly bound in white sheep, and 3s. 6d. bound in calf." About the same time, he executed the cuts for a small child's book, entitled "A pretty Book of Pictures for little Masters and Misses, or Tommy Trip's History of Beasts and Birds;" the cuts in this work (62 in number) are many of them very beautiful, and are faithful representations of the animals therein described. It is to this little book, which is exceedingly scarce that we are indebted for his more finished and celebrated productions, the *History of Quadrupeds*, and the *British Birds*.

In 1783, he cut the blocks for *Select Fables*, published by Saint. These, and some cut for the works before mentioned, were, at the decease of Hall and Elliott, successors to Saint, sold to Wilson and Spence, of York, but some years afterwards came into the possession of Mr. Charnley, of Newcastle, who had them retouched by Charlton Nesbit, and published them in 1820, in the *Select Fables*, uniform with Bewick's other works.

On the 20th April, 1786, he married Isabella, daughter of Robert Elliott, of Ovingham, at St. John's Church: by her he had four children, who are all now alive.

In 1789, he designed and engraved the *Chillingham Wild Bull*, for Marmaduke Tunstall, Esq., in which he introduced, for the only time, a specimen of cross-hatching, on a stone in the foreground. The first impressions taken from this block were four on thin vellum, and a few on paper before he affixed his name. One of these four Bewick kept himself; Mr. John Bell got one; Mr. Beilby one, which was sold in London for £20.; and the late Mr. Solomon Hodgson another, which was sold to Earl Spencer. Very shortly after these impressions were taken (I believe, between the Saturday night and Monday morning), the block, consisting of four squares of box-wood, split and warped, by exposure to the sun. Though this accident was in some measure

remedied, by an iron hoop screwed round the block, the subsequent impressions will be found, I think, to have the junctions of the blocks quite apparent.

The first edition of *Quadrupeds* was published in 1790, the second in 1791, the third in 1792, the fourth in 1800, the fifth in 1807, the sixth in 1811, and the seventh in 1820.

The first, published in 1790, was favourably reviewed in the *Critical, English, Monthly, and Analytical Reviews*, of the day. It consists of 456 pages, and contains 200 wood cuts, and 104 tail pieces: of the latter, many contained in this edition are often reprinted, and some including a considerable number of small ones, are omitted in the following editions. Fifteen hundred copies were printed in demi octavo at 8*s.*, and one hundred on royal at 12*s.*: it was printed, as well as the second, third, and fourth editions by Solomon Hodgson; the remaining ones by Edward Walker.

The second edition, in 1791, consists of 483 pages, containing 212 wood cuts, and 108 tail pieces: many of these, as in the former edition, are re-printed, and some omitted, in subsequent editions. This volume contains 13 new figures, including all the Bats, and there are 17 additional tail pieces in it. Fifteen hundred copies were taken on demi, at 9*s.*, and three hundred on royal octavo, at 12*s.*

The third edition, in 1792, consists of the same number of pages and embellishments as the last: a like number of copies of both kinds was taken, and at the same price.

The fourth, published in 1800, consists of 525 pages, containing 225 wood cuts, and 110 tail pieces: it is the first in which the Linnæan names were introduced. One thousand copies were printed on demi octavo, at 10*s.* 6*d.*, three hundred on royal, at 15*s.*, and two hundred and thirty on imperial, at £1. 1*s.*

The fifth edition, in 1807, and the first printed by Walker, consists of 525 pages, and contains 226 wood cuts, and 111 tail pieces. I cannot ascertain how many copies of different sizes were taken, but they sold for 13*s.* demi, and £1. 11*s.* 6*d.* imperial octavo.

The sixth, published in 1811, has the same number of pages and embellishments. The demi copies sold for £1. 1*s.*

In 1818, twenty-five copies of the *Quadrupeds*, were taken on 4to. paper by Walker, price £2. 2*s*, in sheets. In addition to the *Wild Bull*, for Mr. Tunstall, he cut the *Lion*, *Tiger*, *Elephant*, and *Zebra*, on large blocks, in 1799, for Mr. Pidcock, who was at Newcastle with his Menagerie at that time. From these, Bewick had 150 impressions of the Lion, 200 of the Tiger, 250 of the Elephant, and 150 of the Zebra, struck off before they were put into Mr. Pidcock's hands. The *Lion* he engraved thrice afterwards; once, a plain reverse in position to the one above-mentioned, again in a different attitude, and one a little smaller couchant. He also engraved, on a large block, the design of a *Six-horse Waggon descending a Hill*, for some person at Leeds, who objected to the price when it was sent to him, and returned it; in its passage to or from Leeds, the block was injured, which irritated Bewick considerably.

At the time of his death he was engaged in a beautiful style of wood-cutting, on large blocks, which had for its object to effect a humane improvement in the condition of the Horse, an animal so essentially useful to us, yet, in many cases, so inconsiderately neglected and abused. It occurred to him that any cheap representation of this animal, in a state of evident suffering from want of care and ill treatment, executed with sufficient force to strike the recollection, and awaken the better feelings of those to whom he is usually intrusted, would tend more than any thing to ameliorate his condition. The model he followed, in the execution of this plan, was, "*The old Horse waiting for Death*," introduced in the *Fables* as a vignette. He employed for it four blocks joined together, and backed with two transverse layers of Mahogany, to prevent them from warping, forming a large block of about ten inches by eight. On this he designed, in his happiest style, a wretched old horse, in view of all the comforts of the farm-yard, but without the power of attaining them: an old stone wall, quite a new subject, as he remarked, intervening. In this print, he intended to adopt the use of, at least, two blocks. On the first, which was almost finished when he died, he cut the subject in a crude unfinished manner, omitting the effects of shade, so that the impression conveyed the idea of an unfinished engraving. An impression of this he intended, while damp, to apply to another block, of similar dimensions, which was to be devoted to shade and dark effect alone.

On the Saturday previous to his death, he took the first block, to Walker's, and had four impressions struck, which are now distributed among the four members of his family. One of them had been applied, as above mentioned, to a second block, which bears the impression intended to direct the artist in the distribution of his shading.

He could not, I remember, please himself with the eye for his old horse, and after filling several scraps of paper with old eyes, which would have delighted most people, declared he must wait to copy one from nature.*

The first edition of the *Land Birds*, which constitute volume i. of Bewick's *British Birds*, was printed by Hodgson, in 1797, and the first of the *Water Birds*, vol. ii, by E. Walker, in 1804. The first volume, consisting of 335 pages, at 10*s.* 6*d.* demi, 13*s.* thin royal, 15*s.* thick royal, and £1. 1*s.* imperial octavo; the second volume, consisting of four hundred pages, 12*s.* demi, 15*s.* thin royal, 18*s.* thick royal; and £1 4*s.* imperial. One thousand copies were taken off on the first kind of paper, eight hundred and fifty on the second and third, and twenty-four on the last.

In 1798, an additional number were taken, bearing date 1797, but printed in 1798, seven hundred and fifty on demi, at 10*s.* 6*d.* for the first, and 12*s.* the second volume; six hundred and sixty-nine on royal, at 15*s.* and 18*s.*, and two hundred and seven on imperial octavo, at £1. 1*s.* and £1. 4*s.*

Of the second edition of the two volumes published together by Walker, in 1805, I am unable to state the number of copies taken; and of the third edition, printed by Walker, in 1809, and the fourth, in 1816, I know nothing, but that the latter contains, in its first volume, 329, and in the second, 400 pages.

* This application of several blocks is termed *Chiar'oscuro*; it is of very early invention, being mentioned among the first records of the art. It is claimed by the Italians for Ugo da Carpi, born at Rome, in 1486; and by the Germans, with much shew of reason, for Mair, who practised it in 1499 (while Ugo da Carpi was a boy), and for Lucas Cranach in 1500. It should be remarked, however, that the method employed by the German and Italian masters was so different, as to allow both a fair claim for originality of invention. Papillon *(Histoire de la Gravure en Bois)* gives a specimen in page 154, vol ii., where the four impressions are separately represented.

In 1800, five hundred copies of the *Land Birds* were printed by Hodgson, price 12*s.* on octavo, without the letter-press, but having the tail piece which had been affixed to the birds in the previous edition, on the same page below the bird; this edition did not sell well, and the second volume was not printed; and in 1817, twenty-five copies of the *British Birds* and a few *Foreign Birds*, were printed on 4to. paper, £2. 2*s.* in sheets, by Walker. In the following year, the same number of copies of the *Quadrupeds* were struck off at the same price. These 4to. copies do not contain any letter-press, and partly owing to that circumstance which allows of exclusive attention to fine impressions, and partly to the improvement in the mode of printing, they are incredibly superior to any others. It is a mistaken though rather prevalent idea, that wood blocks being of a softer nature than plates of copper or steel, will wear out sooner, and not afford so many impressions; and that therefore the first editions of works containing wood cuts, must be superior to those of a later date; but it must be observed that a wood cut will print an infinitely greater number of copies than either steel or copper, from the destructive method employed in cleaning the latter, which the printer is obliged to do at every impression, by rubbing it with whiting. This of course very soon wears down the sharper parts of the plate, and in course of time renders it necessary to retouch it, a proceeding, which, in the opinion of connoisseurs, materially diminishes the value of subsequent impressions. A copperplate will afford from one hundred and fifty to seven or eight hundred copies, more or less, according to the fineness of the engraving and the hardness of the plate; those in line giving more than those in mezzotinto, and those in mezzotinto more than aquatinta. A steel plate will give often from six to ten thousand impressions.

Engravings on wood (technically termed cuts) are usually made on box-wood, used the end-way of the grain; they require no cleaning, except a very slight application of alkali when they get clogged with ink, a case which does not soon happen where it is only pressed on the prominent parts with a printer's ball, and not rubbed into the cavities, as in copper.

Mr. Bewick cut a small vignette for the *Newcastle Chronicle*, which headed the local news for more than twenty years, and afforded, during that period, nearly two million impressions. It may be presumed that these were not so clear at last, but to retain a place in the paper, in an intelligible condition, argues pretty fairly for the durability of wood cuts.

What adds not a little to the value of the 4to. copies of Bewick's Works, is the fact that no more are likely to be printed in that manner; for from the want of support, afforded by adjacent types, the blocks were unable to sustain the requisite pressure, and many of them were injured, the bill of one of the *Crows*, and that of the *Nightingale*, among others, being broken. The latter he had just repaired before his death, by introducing a small square of wood in place of the piece originally containing the bill, which was sawed out. This new piece just comprises the whole head of the bird, and has not yet been printed from. In consequence of these accidents to the blocks, the author was determined that no more should be printed without the letter-press, and as his family seem of the same opinion, there appears little probability of their increase.

In 1795, the first edition of Goldsmith's and Parnell's *Poetical Works*, with illustrations by T. & J. Bewick, was published in London, by Wm. Bulmer, price £1. 1*s*., and in 1802, a super-royal octavo, at 15*s*.; and in 1796, Somerville's *Chase*, price £1. 1*s*., and in 1802, a second edition, on super-royal octavo, price 15*s*.

In 1818, the first edition of the *Fables of Æsop and others*, with woodcuts, by Bewick, was published at Newcastle, by E. Walker. It had for its object the promotion of morality among the youth of these kingdoms, and though inferior to his *Birds* and *Beasts*, is deservedly popular. One thousand copies of this edition were printed on demi octavo, at 15*s*., five hundred on royal, at £1. 1*s*., and five hundred on imperial, at £1. 11*s*. 6*d*.

A second edition was published in 1824, 18*s*. demi, and 24*s*. royal octavo.

I extract the following record of one or two rare copies of his *Works* from John Bell's *Catalogue*, printed in 1795.

"A copy of Bewick's *Quadrupeds*, printed on Whatman's fine wove Atlas vellum paper, on which only two copies were printed; new, in boards, £1. 16*s.*"

"Another copy, the cuts only (above 130) taken off upon strong writing paper, music 4to. size, one on a leaf, for colouring, well half-bound, 5*s.*"

"Another copy, the cuts only, proof impressions, on wove demi paper; two, three, and four of the animals on a leaf, and interleaved with writing paper; new, half-bound, a unique book, £1. 10*s.* 6*d.*"

One of the most curious and valuable copies of the *Birds*, is in possession of Mr. Richard R. Wingate, of Percy Street, a man of most accurate observation on subjects of Natural History, but especially Ornithology, his intimate acquaintance with which has enabled him to add a new species of Swan to the list of British Birds, which, though comparatively plentiful, and contained in two or three museums, had escaped the observation of naturalists: he was an old and esteemed friend of Bewick's, and I am indebted to him for many of the circumstances related of him.

This copy consists of a set of light impressions (many of them proofs) taken by Mr. Bewick's leave, under Mr. Wingate's own direction; as a bird-stuffer, and through the author's kindness, all the birds from which the blocks were engraved passed through his hands, and from these very specimens, he coloured with the most scrupulous fidelity, as if he was on his oath (as Bewick observed), the impressions abovementioned. Bewick was highly pleased with the manner in which they were done, and wrote to him a letter expressive of it.* Mr. Beilby also took some

* Dear Richard,

Some little time ago, I examined with attention your coloured impressions of "British Birds," on which, in my opinion, you have bestowed great pains and labour—not in vain, for I think there is in them a fidelity and a nearer approach to truth and nature, than any things of the kind I ever saw.

I hope you will continue to finish the rest in the same excellent way, and that your Books, which I think will be deemed unique, and rise in value in proportion to their singularity, will, at length, reward you for your meritorious skill in making them so complete.

I am (with best wishes), Your's, &c.

THOMAS BEWICK.

pains in colouring a good edition of the *Birds*, which, if accurate and unbroken, must be valuable. And Mr. Murray has, I am informed, a fine copy of the edition on large drawing paper, which has been skilfully coloured. I have a copy of the hundred on 4to, taken in 1825, which in fineness of impression, is curiously superior to any thing I have seen: it is one of four remarkably fine copies which I saw at his house in sheets: with the assistance of his daughter, and in cases of any hesitation, of the old man himself, I compared each four prints throughout, selecting the finest; on the title-page I have his name and declaration in evidence of its choiceness; and here I would remark that his conduct in this, and all transactions I have had with him, was exceedingly liberal, and very much opposed to the closeness which has been attributed to him.

With regard to the circumstance that the *British Birds*, with very few exceptions, were finished by his own hand, I have it in my power to pledge myself. I had been a good deal surprised one day, by hearing a gentleman assert, that very few of them were his own work, all the easy parts being executed by his pupils. I saw him the same day, and talking of his art, inquired if he permitted the assistance of his apprentices in many cases? He said "no, it had seldom happened, and then they had injured the cuts very much." I inquired, if he could remember any of them in which he had received assistance? he said "Aye—I can soon tell you them," and, after a few minutes' consideration, he made out with his daughter's assistance, *The Whimbrel*, *Tufted Duck*, and *Lesser Tern*: he tried to recollect more, and turning to his daughter, said, "Jane, honey, dost thou remember any more?" She considered a little, and said, "no, she did not," but that "certainly there were not half a dozen in all;" these we both pressed him to do over again. "He intended it" he said, but alas! this intention was prevented. In some cases, I am informed, he made his pupils block out for him; that is, furnished them with an outline, and let them cut away the edges of the block to that line; but as in this case, the assistance rendered is much the same as that afforded by a turner's

apprentice when he rounds off the heavy mass of wood, in readiness for a more experienced hand, but not a line of whose performance remains in the beautiful toy it becomes, it does not materially shake the authenticity of the work in question.

In 1825, one hundred copies of the *Land and Water Birds*, and the few *Foreign Birds*, fourteen in number, were printed at £3. 3*s.* sheets; this contains all his birds but six; the *King Duck*, *Harlequin Duck*, *Vulture*, *blue-breasted Robin*, *Reed Wren*, *and cream-coloured Plover*, which he engraved subsequently, in the order in which I give them; of these, the *Vulture* and *blue-breasted Robin* are unique as British Birds; the former was shot on the south coast of England, and the latter, which is now in the museum of the Literary and Philosophical Society, on the Town Moor, near Newcastle.

The only specimen of lithography by Bewick, is a sketch he made in Edinburgh for Ballantine and Robertson, in 1823, to illustrate the long plunging pace of a horse, sometimes called Cadger's trot; it is a highly spirited thing. His engravings on copper are not many. One or two prints of prize cattle for Mr. Spearman and Mr. Hall, and some illustrations to *Reay's Shooter's Guide*, with the engravings for *Consett's Tour*, by Sir H. Liddell, and some Bank Notes, being all that I know of.

The *Quadrupeds* and *Birds* gave quite a new era to the publication of school books; before these appeared, it may be remembered what hideous things were introduced to express the figure of even the commonest animal, and the editions of a school book then in use, entitled, "*Descriptions of* 300 *Animals*," would, from the uncouth figures therein represented, be now considered as quite a curiosity; but in the present books and prints for children, many of the figures may be easily traced to those beautiful designs, which have gained for the subject of this memoir, such deserved celebrity.

As his works advanced in estimation, considerable wonder, not unmixed with incredulity, was evinced at their execution on wood; they so far surpassed all previous attempts in that way, that people were not

immediately persuaded of the fact, and there are many instances, where a comparison of the block and impression were necessary to convince them.

Among the sceptics, was our beloved Monarch, George III.; having seen some of the illustrations of *The Chase*, by Somerville, he was so incredulous that such beautiful impressions could be procured from wooden blocks, that he ordered his bookseller, Mr. George Nicol, to procure the original blocks for his inspection, with which he was well pleased.

Many other celebrated persons have also been much interested in their examination. The Grand Duke Nicholas, of Russia, on his visit to Newcastle, expressed himself highly gratified with them.

In his younger days, he could finish one of his birds, if not accompanied by much foliage, in a day, or sometimes in a few hours; at a later period, though still possessed of excellent eyesight, he could not work so unremittingly, and they occupied a longer time. At one period of his life, he injured, by over-exertion, one of the nerves of the eye, and it was almost feared at the time, that he would never fully recover his strength of sight; happily for the world he did so completely.

In a work entitled "*Religious Emblems*," published by Ackerman, he says, "The Bewicks of Newcastle were the first to bring this art (wood engraving) to any perfection; with what success they have practised it, their works on Natural History, which are in every body's hands, sufficiently evince, and it is no small addition to their praise, that to the pupils of this school we owe every work of celebrity that has since been executed."

During his apprenticeship he was much noticed by Mr. Gilbert Gray bookbinder, (father of the late George Gray, fruit-painter,) who had been brought up in the shop of Allan Ramsay, author of the "*Gentle Shepherd*;" and who, to his own shrewd observations on men and things, added much that he had learned from his celebrated master.

Whilst Bewick was at work, Mr. Gray, who was much respected in Newcastle, used often to sit beside him, and perhaps in his strong good

sense and knowledge of character, we may trace the origin of the same qualities for which Bewick was so remarkable.

His language was extremely forcible, and the words he made use of, those calculated in the plainest and most familiar manner to convey his meaning; I regret that partly on this account, which rendered his expressions, at times, rather coarse, and partly from the difficulty of conveying the character of his dialect, dependent in a great measure on variety of intonation, I must abstain from introducing here what might otherwise have been amusing.

In consequence of this difficulty in giving the idea of his pronunciation, I shall remark that it was undisguisedly broad, though without the burr or mal-pronunciation of the letter R, characteristic of most Northumbrians,

"Like Hotspur speaking thick,"

but with all their variety of intonation, and leave the rest to the imagination of the reader.

His own sketches of the language of his countrymen, are among the best I know; they are recollections of scenes which had made an impression in his youth, and were sometimes written on scraps of paper for the amusement of his friends; I subjoin a fragment of one.*

* "Aehy—Aehy"—kih she, "yeh may say what yeh leyke, but Ize suer aws reet, aw ken weel eneugh when he was bwoarn, fir I meynd aw was up at the Mistrisses suen ee th' moarning, ith th' howl oh wounter, when in cam little Jenny runnin—'Muther! Muther! sez she, there cums little Andra Karr, plish-plash throw the clarts, thockin and blowin, wiv his heels poppin out ov clogs every step, leyke twe little reed taties—wiv a hare's scut iv his hat, and the crown of his head and teheyteed hair stannin up throw't'—'poor fellow (sez the Mistress) aws warn a keahm hesn't been iv his head this twe months—Andra, Andra!—whats the mayter? * * * * Whees there' (sez the Mistris)? 'Wey, there's our Dehym, an Isbel, and Barbary, an aw so oad Mary, cummin tappy lappy owr the Stob-Cross-Hill, and Jack Gorfoot gallopin by Anty's garth neuk on the oad gray meer, with Margery the Howdy behint him, fit to brik their necks'—'Aehy (sez the Mistris) an I mun away tee—whares the' fayther Andra?'—'Wey (sez Andra,) I so him stannun at th' lown end oh the Byer, wouv his jazey neet cap on, and his hands iv his kwoat pockets, beayth thrimpt owr his thees—an glowrin about, but I saw nowse he wis leukin at.'—'Sit down Andra—oh the trow steahyn'—see doon sat Andra, and weyhpt his nwoase on his kwoat kuff—'meayk heayst lass, an bring him (poor fella) a shive of butter an breed—cut him a good lounge, an strenkle a teahyt oh sugar on't,'" &c.

This was not the style of his own language, for though interspersed with expressive words of an original description, his grammar was perfectly correct, and his words very well chosen—these he uttered with a kind of serious earnestness, quite his own, and sometimes expressed his ideas in a language simple but expressive, and with a tone so energetic and solemn, as to impart a degree of grandeur to his conversation, particularly when it turned on the beauties of nature, or the wonderful and benevolent provision of its great Author, a feeling of which he was at all times exceedingly susceptible.

The similarity of his character with that of Robert Burns, always forcibly struck me: the same strength of understanding, keenness of observation, and simple originality of thought and expression, seemed peculiar to both; and many minor points were not wanting to finish the likeness; humanity and tenderness of disposition, quick perception of the ridiculous, with eminent power in pourtraying it, occurring among the rest; but the feature which renders the likeness most striking, is their common understanding, and consequent admiration and regard for nature. If Burns had been a painter, his subjects would have possessed much of the style of Bewick's vignettes; and if Bewick had been a poet, his productions would have resembled in a certain degree the compositions of Burns.

The idea of Socrates "that the summit of our knowledge is only to perceive our own ignorance," was a great favourite with him: he had it (whence I know not) in a poetic form, thus—

> "What is discovered only serves to shew,
> "That nothing's known, to what is yet to know."

He used to quote it with great emphasis and solemnity, and often added some such remark as "Why sir, it would take a man a life time, to write the history of a spider." I heard him use these two expressions to some one who was praising him for the benefit he had conferred on mankind, as a naturalist.

My acquaintance with him commenced in the summer of 1825; my youngest brother, who, from his childhood, had been an observer of nature, obtained at Tirrell near Penrith, the nest and eggs of a bird

which had not before come under his observation; on consulting Bewick's *Birds*, he unhesitatingly recognized the *Pied Flycatcher*, and as the author in his description of this bird, seems somewhat at a loss upon the subject of its nidification, we called on him that he might have the benefit of our observations: he was exceedingly kind, and expressed himself obliged, taking memoranda on the margin of an edition of the *Birds*, seemingly kept for the purpose, as it was, to all appearance, pretty full of such notes.

At that time, and he scarcely changed during my intimacy with him, he was a stout fine looking old man, five feet ten or eleven inches in height, very well made, with nothing remarkable in his costume, except a brown silk cap, which he usually wore when sitting at work.

When animated in conversation, and he was seldom otherwise, his eye was peculiarly fine, and imparted a vivacity to his countenance very difficult to describe or forget: there was more of intelligent benevolence and candour in it than I ever saw in another, but it was mixed with an earnest gravity almost bordering on severity, when speaking in disapproval, and with the brightest animation, when discussing the beauties and wonders of nature, or subjects of equal interest.

Between the two extremes, there was a wonderous versatility of expression, which never for a moment suffered his countenance to remain the same; in his younger days a painter of the name of Bell tried sedulously for more than three weeks to paint a likeness of him, and was compelled at last to give it up, with the declaration that it was impossible to paint him.

He usually kept a quid of tobacco in his under lip, as represented by Bailey in the bust, and when he became energetic transferred it *pro tempore* to the table before him, and resumed it when his fervour was abated.

I do not think that any of the prints published of Bewick, are good likenesses, though I am told Burnett's engraving from Ramsay's painting, was so at the time it was taken; it always struck me that there was a round stout vulgarity about them, which he had not, and I

can scarcely imagine them to have been good likenesses of his highly intellectual countenance.

Bailey's bust in the library of the Literary and Philosophical Society, of this town, is certainly the best representation of him, giving the very spirit and expression of his face, and descending to the peculiarities of the veins on the temple, the quid in the lip, and the tufts of hair in the ears: he had, however, an excellent full length small likeness taken by Good, a short time previous to his death, which though done when he was not in good health, and therefore representing him too thin, still gives an excellent idea of the old man: all the animation and intelligence is there, and the subsidiary parts of the picture are good. Mr. Charnley possesses also another good likeness done by Nicholson, when Bewick was at Chillingham; it is merely a drawing in water colour, but is very like.

The impression, when we took our leave on our first visit, was a very pleasing one; he earnestly pressed us to go and see him often, and such was the gratification I immediately experienced in his society, that an excuse half as good would have entailed on him much of my company; as it was, I used to be with him two or three times a week, and always met with the same cordial welcome, or kind reproval for not coming more frequently.

I look back now with feelings of the greatest satisfaction to the pleasant and instructive hours I have spent with him, and am only diffident of my power to do justice to the recollections of them, particularly as the road I travel is new to me, and my only directors, those unsatisfactory mile-posts of memory, desultory memoranda, penned down as opportunity or inclination dictated. These, by the bye, were, I find, commenced at his suggestion, as the first memorial of him that I possess in writing is at the commencement of some such fancy repository, and is merely a note to that effect.

He used to say it was such a source of melancholy satisfaction to him to recal the bright hours spent with those who have left us, that he insisted in my pursuing the same method to perpetuate them.

He kept an obituary too, and intended it to blend and keep pace with

a life of himself, which he meant to embellish with likenesses of his friends, drawn from memory or otherwise. This talent he possessed in an eminent degree while a young man, and could, long after he had seen persons, draw most striking likenesses of them. It was not confined, however, to likenesses of his friends, as the origin of one of the tail pieces shews. I allude to one where the devil is represented horse-whipping a man under the gallows. A man had been long in the habit of supplying his family with coals, when he discovered that he had been the dupe of an ingenious system of peculation throughout. Bewick drew a striking likeness of him in the above predicament, and, going to the door, called him mildly into the house, and shewed him the picture, with this pithy admonition, "Now then, if thou goes on as thou has been doing wi' me, the devil will get thee, and tak thee to the gallows." Of course the fellow slunk off somewhat disconcerted.

In this case, neither his mental nor bodily powers were excited much, but there were occasions when, under the influence of anger, he must have been a rather formidable antagonist. In the commencement of his celebrity he was obliged to visit London for the purpose of making arrangements with some of the booksellers for the sale of his works. On this occasion he met with much to irritate and disgust him. To a man of his simplicity and integrity, the insincerity and hollowness so abundant in our modern Babylon, could not fail to be offensive, and when to these ingredients a small portion of impertinence was added, induced often by his quiet unpresuming deportment, they formed an inflammable mixture, which roused the lion to a display of his powers, more amusing to the spectators than to the discomfited object of his wrath.

The particulars of these rencontres, I do not now remember, only as he detailed them they were generally accompanied by some quaint admonition, which, if delivered with aught of the humour he infused on relating them to me, must have produced a rather *equivocal* effect.

His humanity was very extensive; cherishing continually some scheme for the improvement of his fellow creatures, or the better treatment of animals intrusted to them. This it was which led him to publish the *Fables*, and in fact all his works. Some had this object

exclusively in view, as the print of the *Old Horse*, mentioned before ; and this feeling produced a kindness and consideration towards every creature about him.

Among the rest a shepherd's dog had grown much attached to him, and was his constant companion. It was in his younger days, when his sociality of disposition led him more into company than at a later period he was inclined to indulge in. On these occasions *Cheviot* usually waited for his master at the door, but sometimes on a very cold inclement night he took him into the house with him. Once, when he had been admitted in this way, some one remarked, "Are you not afraid of his bringing fleas into the house ; had you not better put him out?" Bewick answered, in his serio-comic way, "I should have no objection at all, but (poor fellow) he has not brought his great coat."

Of course the wanton destruction of life met with his greatest disapprobation, and, on one occasion, produced a pretty strong remonstrance to some young men engaged in shooting swallows. It contained nothing remarkable, but the truism with which he concluded it ; "That they were destroying creatures of infinitely more use than themselves." This carried conviction and produced the desired effect.

He could not bear to see a woman or a horse ill treated : I remember seeing him very much excited, after witnessing a blow given by a brutal fellow to a woman. "I sprung forward, Mr. Atkinson, to knock him down, but I remembered that I was only a useless old man, and might get myself abused without doing any good : so I told him what I thought, and shamed him out of meddling with her."

On the subject of death he was often painfully familiar ; his father and grandfather had both died about the age of 70, and he had a kind of presentiment that the same period would be fatal also to him ; he survived it however, and used to remark "that he had now got a new lease of life, and might go on for years, though as we are only tenants at will, he might receive warning any day. He was not afraid to die, though he did not wish for its approach, and when I arrived at his age I should feel the same indifference." The reflections produced by his study of nature, had been to him the most pleasant, and convincing of

the presence of an All-wise Being that could be imagined, and very often, has he urged to me the delight and satisfaction it must be to all, who indulge in it. Every circumstance of her economy, was subject of wonder and speculation to him, and he could scarcely imagine others to be so apathetic as not to admire. "Ah!—I've wondered and wondered to see the little water spiders dancing so light on the top of the water, and then—down they go in an instant,—its very wonderful."

Thus he concluded a lecture on Natural History which he had one day been giving me, suggesting as he always did, a curious and amusing subject for investigation and reflection.

In conversations I had with him on the subject of rare birds which had come under his observation, I was much surprised at his mentioning two, which have never, in the slightest degree, been looked on as British. One of the *Jacanas* he was confident he had seen when a young man (caught either by himself, or when he was present), in a bog near Bywell; and as a boy he remembered two birds being shot on the ash trees in Ovingham church-yard, which he always thought were Cardinal Grosbeaks. The latter, it is just possible, might have escaped from confinement, in the other case that is out of the question. This information, though only derived from the recollections of boyhood, is curious, as coming from a man of Bewick's observation.

Cant and hypocrisy he very much disliked; a ranter took up his abode near Cherry Burn, and used daily to horrify the country people with very familiar details of ultra stygian proceedings. Bewick went to hear him, and after listening patiently for some time to a blasphemous recital of such horrors, at which the poor people were gaping with affright, he got behind the holder-forth, and pinching his elbow, addressed him when he turned round with great solemnity; "Now then "thou seems to know a great deal about the devil, and has been fright-"ening us a long while about him! can thou tell me whether he wears "his own hair or a wig?"

His strong sense and independence were such, that he never would flatter or yield to any person, superior to him only in rank; and conse-

quently his language bore the same simple form to every one. A person of high rank, so well known as a patron of the fine arts, called one day to see him at his shop. He was at work before the window, but turned round on his seat as his noble visitor entered the room, and paid his respects in the following unsophisticated way—"How do you do, sir? and are ye quite well? Sit down—sit down—how's your father?"

This unceremonious kind of speech, which in most men would have savoured very much of ignorance and incivility, to say nothing of unpardonable disrespect to a man of snch consequencee, came from him in a manner so simple, with such kindness and cordiality of tone, that the most fastidious and arrogant person could scarcely have been offended.

As a back ground to the cut of the *Magpie*, he has introduced the carcase of an old horse; and to this, a tale is attached: a neighbour wanted a horse to go to Newburn with, and borrowed an old favourite of Bewick's father, under strict promise of good usage: he neglected the conditions, and overworked the horse, which died soon after, and my kind-hearted old friend used to step aside in going to school, to see and shed a tear over the old horse. In his relations of this and similar circumstances, there was nothing mawkish or unnatural, they came from him as the genuine feelings of his heart, and it was impossible for a moment to suppose they arose from any affectation of feeling: thus, though there is nothing very extraordinary in the fact, that he never killed a bird, but once by accident with a stone, it serves to shew the native humanity, and disinclination to injure any thing, for which he was remarkable.

When I was with him one morning, after some conversation on indifferent subjects, he said, "are you a collector of relics, Mr. Atkinson? scarcely knowing to what this tended, I answered in the affirmative; should you like to possess one of me? I expressed the high satisfaction I should experience in a memorial of him, and he took from the drawer of the table he was engraving at, a small packet of paper, which on

being unfolded, displayed—a tooth, the paper contained the following inscription :—

I departed from
the Place,—
from the place I held
in the Service
of
Thomas Bewick,
after being there upwards of
74 Years,
on the 20th November, 1827.

On the back was written "Bewick's Tooth," November, 1857.

The tail-piece after the *Moor Buzzard*, in the 4th edition (1816), of two old men carrying water between them on a pole, is the likeness of two old men at Ovingham, the one on the right is "auld Tommy Dobson, of the Bleach Green," and the other is "Mat. Carr."

The *Fieldfare*, page 126, of the same edition, was a great favourite ; it is in a tail-piece to that bird that the devil is represented chastising the coal-heaver.

In consequence of the easy adaptation of wood cutting to any subject, where considerable masses of light are required, aided by his intimate acquaintance with every effect of natural scenery, we find his winter pieces, with snow, abundant in beauty and fidelity of representation : nothing can surpass the poaching scene in the snow at page 222, or the wintry desolate appearance of the hills in the vignette at page 160, in the second volume, where a poor man in a fit of false economy, is fording the river with his cow to save the toll : he appears sensible of the indiscretion of his proceeding, and would fain withdraw her and himself, particularly as his hat seems averse to the measure, and the shouts of some men on the other side, together with the coldly encroaching element, suggest to him the probability of deeper water in advance. The cow, poor thing, (as Bewick would say) seems to be gifted with all the pleasing perseverance of her sex, and determines

to go on, which is the cause of the variety of opinion so apparent in the vignette.

His power of giving each characteristic of animals, even at a distance, was extraordinary; it is exemplified in his distant flights of birds, which can always be recognized; and when he gives to them any cause of excitement, they are highly entertaining: as an illustration of this, I would call the attention of the reader to a very beautiful vignette at page 109, vol i. of two cows drinking; above which we have most intelligibly depicted the futile attempts of a hawk to make his escape from the buffettings of two tyrannical crows; the magpies, like school-boys, only being there to see the fun.

The back ground to the *Blackbird* (123), is a view of Cherry Burn.

His idea of the old farmer so excessively drunk, within sight of his own house, as not to be able to lie still without laying hold of the ground, which he seems eagerly endeavouring to accomplish, is explained by the date on the stone in the foreground.

He could never, he said, please himself in his representations of water in a state of motion, and a horse galloping: his taste must have been fastidious indeed, if that beautiful moonlight scene at sea (120 v. ii.), the river scene at 126, the sea breaking among the rocks at 168, or 177, or 200, or 216; or the rippling of the water as it laves the feet of the old fisherman at page 95, did not satisfy him: I am inclined to think it was only with water in a falling state that he could not please himself, as in some cases he makes his representation of it assume a rather stiff appearance: of his horse galloping, too, I think he spoke too severely: at least he gives one at page 261, vol. i. which seems very easy and natural in its motion.

I often urged to him the propriety of publishing, as an accompaniment to the *British Birds*, the figures of their eggs, and for a long time —in fact till the period of his death—he entertained the idea: he was fully aware, how much a work of this kind was required, and had even decided on doing it in aquatint, for the better reception of colours.

He intended to lay under requisition in this undertaking the high talents of his daughter, Miss Jane Bewick, and I fear it is to her

diffidence of her own talent, that we are to attribute the absence of this, and many other memorials of a name so interesting to naturalists.

In drawing the *Birds*, his sketches of the *Woodcock* and *Corncrake*, were from living specimens, the former of these is quite the perfection of his complication of talent; displaying his usual intricate knowledge of the habits of the bird, in the character of the back ground, unrivalled facility of pencil in his design, and a skill which cannot easily be equalled in engraving it. His *Skylark* is almost equally good, so is the *Yellow Hammer*, *Wood Lark*, *Night Jar*, *Wryneck*, *Domestic Cock*, *Peacock*, *Turkey*, *Quail*, *Partridge*, *Bittern*, *Snipe*, *&c. &c.*

In engraving them, a very imperfect outline sufficed: in the vignettes he often worked without any, though he had some blocks usually by him, with most humourous designs on them, ready for his graver, which he used to exhibit for the amusement of his visitors: one I remember was a parcel of old men and boys, conning over the bills stuck up at the corner of the street; a large advertisement seems particularly to engross their attention; it is one of an abridgment of the *Law of England* in 500 volumes!

His inducement for writing a life of himself, which he did, and he meant to intersperse with profile likenesses of his friends, was, seeing in the introduction to a novel called "*Such is the World*," published by Whitaker, in 1821, an erroneous statement of the circumstances attendant on the prefixture of his thumb mark to Gay's *Fables*. This determined him to give to the world a life of himself, which, considering his originality, force of language, and strength of understanding, must be a work of considerable interest, particularly, when it is to contain likenesses of those with whom he was intimate.

Could I have persuaded myself of a possibility, that the members of his family would be induced to publish it I should certainly not have obtruded this imperfect notice of him; and my only reason for doing so now, is, that hitherto no memoir of him has been published at the place where he was so well known and respected.

And now I come to the mournful circumstance of his dissolution: I saw him on the Saturday previous in excellent health and spirits; on

the Sunday or Monday he was taken ill, and after a few days' illness, the world was deprived of a man who had rendered himself eminent for his talent, and esteemed for his virtues.

He was buried in Ovingham Church-Yard, at the west end of the church, near the steeple, against which is fixed the family tomb-stone.

The parish register contains the following record of it.

Name.	*Abode.*	*When Buried.*	*Age.*
Thomas Bewick,	of Cherry Burn,	Nov. 13th, 1828,	75.

In conclusion, I have to express the obligation I am under to different gentlemen, for the information they have afforded me concerning him; particularly to Mr. Wm. Garret, Mr. John Bell, and Mr. Richard Wingate, from all of whom I have received much that is interesting.

XVII.—*Description of a Group of* Dykes, *termed Riders, discovered in the Whitehaven Colliery. By* Mr. Williamson Peile.

Read July 20, 1830.

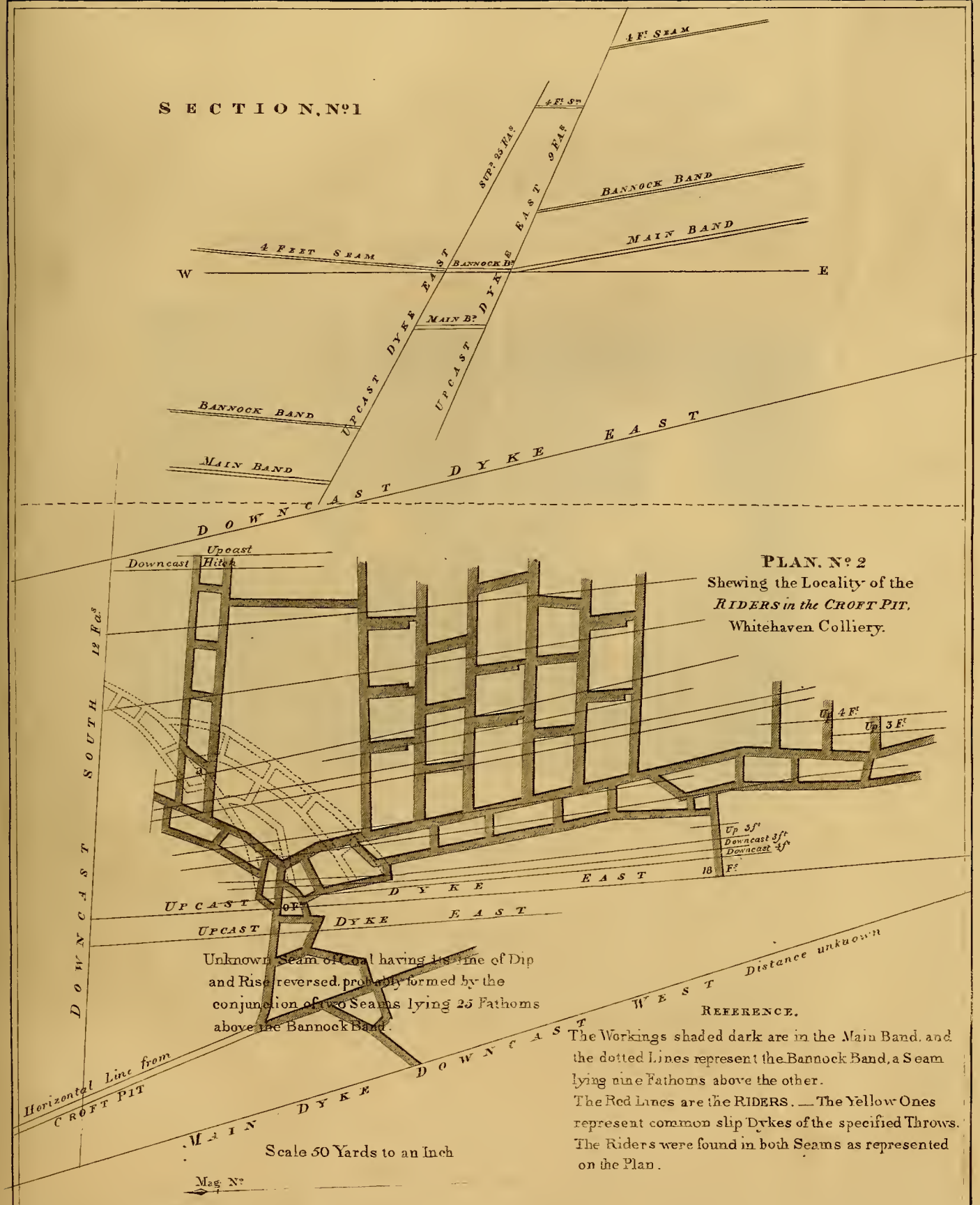
The subject of the various dislocations of strata met with in collieries, and included under the general name of Dykes, is one of so much interest and importance to geologists and miners, that it is hoped no apology will be needed, for laying before the Society the following description of some singular Dykes, which have lately been found in the workings of the Croft Pit, in this colliery. They offer too little obstruction to the progress of the collier to entitle them to much of his attention, but an account of them may, perhaps, be acceptable to persons interested in the science of Geology, as adding another link to the chain of facts illustrative of these most singular occurrences.

As additional of a further interest to the subject before us, it may be well to state, that similar Dykes, have never as far as I can learn, been met with, in any other, than the Whitehaven Colliery. Here, also, their occurrence is very rare, and always confined to the vicinity of large Slip Dykes, similar to the locality we are now attending to; in which a group of them, each preserving the general features of the whole, has been found.

Plan, No. 1., Plate XIV., shews their situation, and the great confusion of the district, which, will perhaps, be rendered more apparent by the section No. 2, Plate XIV. The lines shaded yellow, are ordinary Slip Dykes; the red represent the Riders.

The excavations shewn on the plan are in the Main Band, or principal seam of the Whitehaven district. Its depth below the surface, at the place referred to, is about 170 fathoms.

It will be seen by the plan, that a Downcast Dyke, southwards of 12


SECTION, Nº1
4 Fr Seam
4 Fr Sm
Sup? 25 Fas
9 Fas
Bannock Band
Main Band
4 Feet Seam
W
Bannock Br
E
Main Br
Upcast Dyke East
Upcast Dyke East
Bannock Band
Main Band
Downcast East Dyke
Upcast
Downcast
Hitch
PLAN. Nº 2
Shewing the Locality of the
RIDERS in the CROFT PIT,
Whitehaven Colliery.
Up 4 Ft
Up 3 Ft
Up 3 Ft
Downcast 3 Ft
Downcast 4 Ft
18 Fr
Downcast South 12 Fas
Upcast
Dyke East
Upcast
Dyke East
Unknown Seam of Coal having the line of Dip
and Rise reversed, probably formed by the
conjunction of two Seams lying 25 Fathoms
above the Bannock Band.
Downcast West Distance unknown
Horizontal Line from
CROFT PIT
Main Dyke
Scale 50 Yards to an Inch
Mag. Nº
REFERENCE.
The Workings shaded dark are in the Main Band, and
the dotted Lines represent the Bannock Band, a Seam
lying nine Fathoms above the other.
The Red Lines are the RIDERS. — The Yellow Ones
represent common slip Dykes of the specified Throws.
The Riders were found in both Seams as represented
on the Plan.

fathoms (thickening however in its progress westward), runs in a nearly east and west course; and is met by two north and south Dykes, each upcasting to the eastward. In the angle contained by these Dykes, we find the position of the Riders, which run nearly parallel to the two upcasts, and at no great distance from them.

No. 1. No. 2.

The above are two sections, or profiles, of one of the Riders (marked *a* on the plan), as shewn on the two sides of the working that had crossed it, and which was about four yards wide.

The singularity of its appearance is very striking, and it will be conceived how varied are the forms they assume, by the difference between two sections of the same Rider at so short a distance.

The substances composing it are as follows:—*a*, *a*, *a*, Grey Sandstone, more or less compact, but generally, as in the large specimen,

(No. 1.*), exceedingly hard and ponderous; of which the main body of the Dyke is composed. It is mixed, most strangely, with pieces of Coal of all shapes and sizes, which have generally preserved their quality and shining lustre, burn well, and seem in no way altered from their original state, when clear of the Dyke. In some pieces, however, that I have examined, I found the Coal altered. It had lost its texture, was become soft, and greasy to the touch, and much resembled the outside coating of a piece of wood which had been charred, and buried in a damp place. As this appearance frequently occurs when the Coal is free from all Dykes, it cannot, however, be considered as characteristic of the effect of the Rider.

b. b. b. Black Metal Stone (specimen No. 2.), in small pieces, which had protruded themselves from the roof into the Sandstone, for about 12 inches. They are not to be found in any other part of the section, and belong to the stratum forming the roof of the seam. The colour is somewhat altered.

c. c. c. This singular substance is apparently aluminous, and both its nature and situation in the section, are well shewn by the specimen No. 3. It will be seen to have forced itself into all the *cleats*, or cleavages, of the Coal, and exhibits a shining polished face at its contact with the Coal. In some cases Lime, and even Sandstone, seem to have been substituted, and are also polished at their surfaces.

Of the two sections before us, No. 1 is, in many respects, the most singular, as being more varied, and the insulated situation of the pieces of Coal more remarkable. The great body of Sandstone in the centre, from which the branch, to the left hand, springs, was perfectly free from any intermixture with pieces of Coal, but on the right hand, most especially near the roof, the Coal and Sandstone were mixed up in the greatest confusion.

From the extreme point on the right hand, several very thin shoots of the aluminous substance (*c*) were seen darting through the Coal, fol-

* These numbers refer to specimens presented to illustrate this paper, and which may be seen in the Society's collection.

lowing, however, the direction of the main body of the Rider, as shewn by the section.

The insulated large pieces of Coal were perfectly free internally from any mixture with the stone, but the small pieces on the right hand (of which specimen No. 4 is one) presents so singular an appearance as almost to tempt me to call on Mineralogy, for a new application to the term *Plum-pudding Stone*, to convey an idea of the very great mixture.

I have nothing to add to the section No. 2., the substances were the same, and their situation is well represented.

These Riders were not first discovered in the Main Band, but were found in the workings of the Bannock Band, a seam which there lies 9 fathoms above the other, and which workings proved the course of the Riders very accurately. Some time afterwards when the Main Band was wrought underneath, we were surprised to find that they existed also there, bearing the same features as in their higher position, and directly under the other; thus shewing the exact perpendicular course they have preserved in their passage through the strata. And since we have thus found them in two seams, without a limit to their course, appearing either in the roof of the higher, or thill of the lower seam, it is fair to infer the probability of their cutting all the strata of the Coal formation from the surface to its lowest member. It must be admitted that a different idea might be countenanced by an inspection of the section, viz. that they have darted at several intervals from the Upcast Dyke, perpendicularly into the strata, and it is further evident from the position of the Black Metal Stone in the profile, that the passage of the Dyke has been *downwards;* but to correct this, I must add that the section is not laid down to an accurate scale, and was intended merely to simplify the description of the Dykes. Probably the *hade* of the upcast is much less than represented—and the distance from it to the Riders is contracted in the section.

The Riders, in general, but not always, throw the seam a few inches out of its level, the upcast being to the eastward. The great parallelism

with which they run will at once be seen by an inspection of the plan, and the course by compass is about north 10° west.

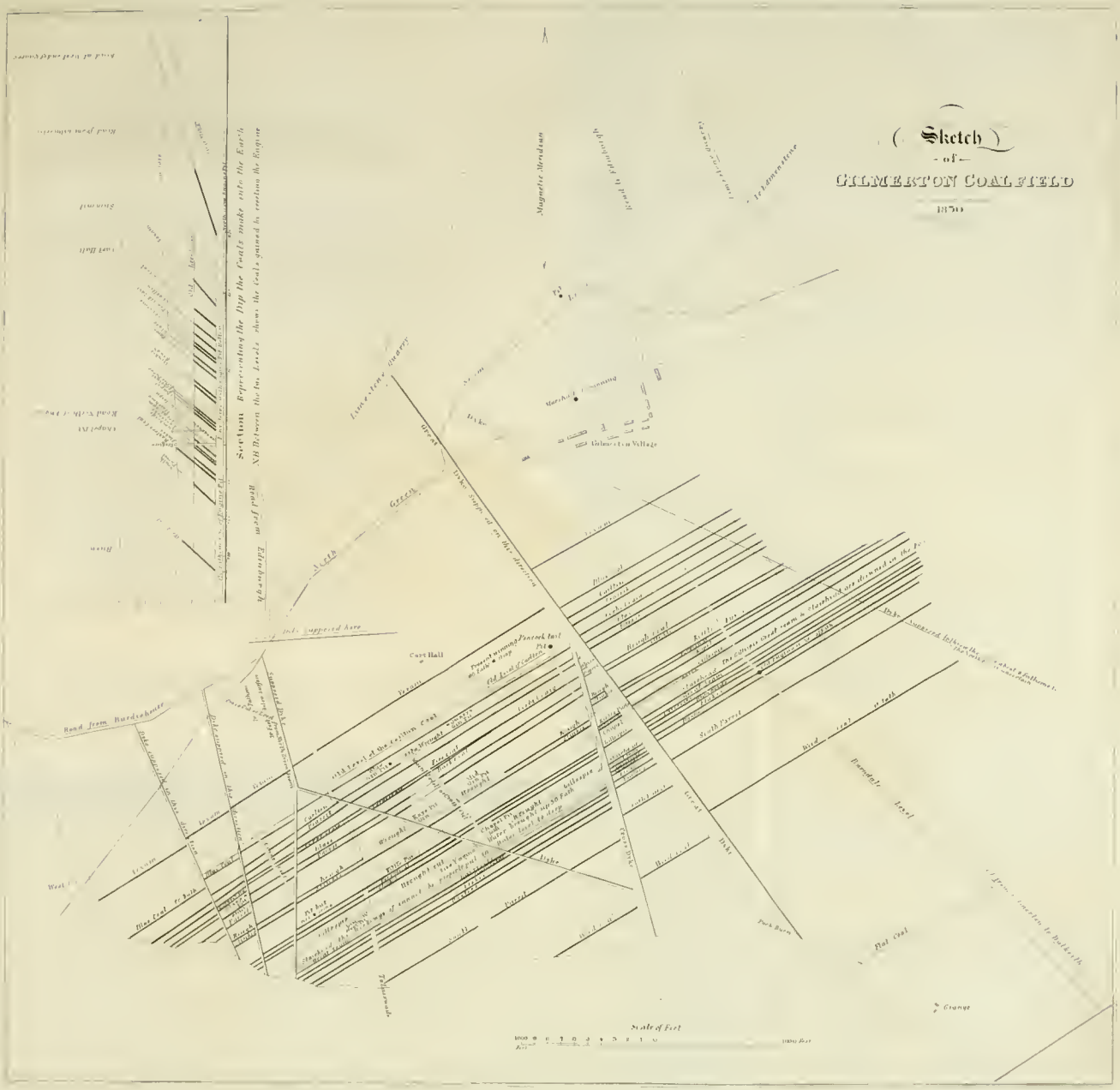
The general course of the large Dykes in this district, it may be observed, is north and south; small deviations to the east and west being however commonly found. The course of the 12-fathom Dyke may, therefore, be considered as rare.

I have not thought it necessary to lay sections of more than one Rider before the Society, as that will be sufficient to give a general idea of their nature; and from the great variety of their appearance, it would be useless to attempt more. It may, however, be well to add that I have not been able to detect in any other, that curious branching to the left, which characterizes the profile No. 1. In general, they are thicker, and the Stone most free from mixture with the Coal about the middle of the seam, and it is near the roof and thill that the singular confusion of Coal and Stone is found. Large insulated pieces of Coal resembling those in the section, are of common occurrence.

The question which naturally arises on examining these singular dislocations, viz. as to their *origin*, is one which, I doubt, must long remain in the deepest obscurity. That a connection exists between them and the Upcast Dykes is, however, evident from their position, and that the cause has not been igneous, is proved by the perfection of the insulated and mixed pieces of Coal. Such appear the only *data*; and to comprehend them, we are forced to revert to that time, when the now solid stratum of Coal must have been so far in a fluid state as to receive and retain the shape impressed on it by the more hard and dense substance of the Sandstone.

P. S. The accompanying Plan, (No. 1. Pl. XIV.) shews the extent of the workings up to the period of its being engraved, in the month of October, 1800.

FRITH OF FORTH
Fisherrow
Portobello
From Edinburgh
To Musselburgh
Old Engine
Duddingstone Coll.y
Grange
Brunstane Coll.y
New Hailes Coll.y
Rail way
Craighall Coll.y
Niddrie Coll.y
River Esk
Edinburgh and Dalkeith Rail way
Edmonstone Coll.y
Niddrie Burn
COALS OF EDGE
Woolmet Coll.y
M.r Wauchope's House
From Edinburgh
Sheriff Hall Coll.y
Lugton Coll.y
Drum Coll.y
Somersides Coll.y
Dalkeith
Caldhame
Puffett
Bennets
To Kelso
Lugton Burn
North Esk
Line of Section
South Esk
Hill head
Kail
Gilmerton Coll.y
From Edinburgh
RANGE
outcrop of Limestone
Melville Coll.y
Newbottle
THE MARQUESS OF LOTHIAN'S COLLIERIES
East Houses
Viewfield
Daffie
Roman camp
Eldin
Vogrie Coll.y
Laswade
River Tyne
To Haddington
Sketch
in ILLUSTRATION of the
NOTICE OF THE EDGE SEAMS
of
MID-LOTHIAN.
Scale an Inch to a Mile
Cellard Sculp.t
DISTRICT ABOUNDING
IN COAL
BUT VERY LITTLE OPENED


Sketch
of
GILMERTON COAL FIELD
1830
Magnetic Meridian
Gilmerton Village
Cart Hall
Road from Burdyehouse
Road from Edinburgh
Scale of Feet
Grange

No. XVIII.—*Notice of the Edge Seams of Mid-Lothian, with a Description of Gilmerton Colliery, now working the lowest of the Series, called the North Green Seam. By* Mr. Matthias Dunn, Colliery Viewer.

Read, August 16, 1830.

The suite of Edge Seams which traverse this district are seen cropping out on the shore of the Frith of Forth, in the neighbourhood of Portobello, the streak, or water-level course bearing about south 20° west, with a north-west rise and south-east dip.

They were originally won by sea-levels, and subsequently at lower depths by engines, in the several estates of Duddingstone, Brunstane, Niddrie, Edmondstone, Drum, Gilmerton, &c. They comprise about twenty-four workable beds of Coal, and their thickness and distance from each other, in Niddrie Colliery, are as under.

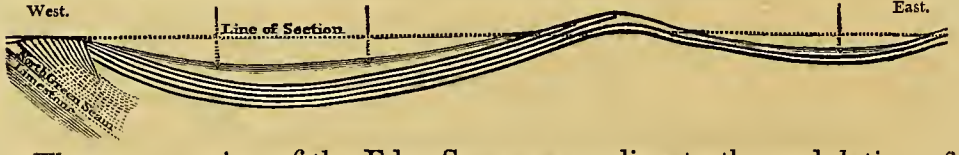
CLASSIFICATION OF SEAMS IN NIDDRIE COLLIERY.

North-Eastern Division.

	Fathoms. asunder.	*Thickness. Ft.*	*In.*
1. Gramachome or Diamond Coal,	—	5	10
2. From Ditto to Salter's Coal,	48	4	10
3. Further to 9-Feet Coal,	8½	5	0
4. Ditto to 15-Feet Coal,	5	7	0
5. Ditto to 4-Feet Coal,	13½	3	0
6. Dito to 7-Feet Coal,	7½	5	4
Middle Division.			
1. Ditto to South Parrott,	300	2	4
2. Ditto to Wood Coal,	29	2	7
3. Ditto to Flake's Coal,	13	3	0
4. Ditto to Rumble Coal,	13	2	9
5. Ditto to Laverock Coal,	1	2	0
6. Ditto to Great Seam,	6	6	8
7. Ditto to Stair-head Ditto,	8	4	2
8. Ditto to Great Gilhespie,	11	3	10
Forward,	463½	58	4

	Fathoms, asunder.	*Thickness. Ft.*	*In.*
Brought forward,.....	463½	58	4
North-Western Division.			
1. From Great Gilhespie to Little Gilhespie,.....	30	2	7
2. Further to Corby Craig, ...	6	5	0
3. Ditto to Stenkie Coal, ...	12½	2	10
4. Ditto to Little Splint, ...	4	3	0
5. Ditto to Peacock Tail,.....	10½	4	3
6. Ditto to Real Corby, ...	14½	4	6
7. Ditto to Carlton, ...	59	4	10
8. Ditto to Blue Coal, ...	8	2	6
9. Ditto to Diamond Coal, ...	59	2	7
10. Ditto to North Green Seam, ...	57	4	3
Total,.....	724	94	8

The easternmost of these seams at the outcrop are the most upright, and may be seen in the neighbourhood of Mr. Wauchope's House, at Edmondstone nearly perpendicular. The lower seams so progressively diverge from the perpendicular (*see* the accompanying profile) that the North Green, or Lowest Seam, worked at the out-crop, lies at an angle of 30° with the horizon.



The out-cropping of the Edge Seams, according to the undulation of the surface, occupies a space from south-east to north-west of 1000 or 1500 yards.

I cannot make out that ever the flat Coals of Edmondstone and Sheriff Hall were pursued to a junction or continuation of the Edge Seams, and, were the prevailing opinion of the Coal Managers of the district, and the section of the sinkings of the above mentioned Collieries to be taken as evidence, they are *not* continuous; the easternmost of the Edge Coals never yet having been sunk to in the valley approaching the North Esk, the following account of which will enable a judgment to be formed.*

* Mr. Bald, in a communication to the Royal Society of Edinburgh, calculates that, in the lowest part of the basin, the undermost Coal would be 500 fathoms deep.

SEAMS OF COAL SUNK THROUGH AT EDMONSTONE COLLIERY, WITHIN 1000 YARDS OF THE EDGE COALS.

	Fathoms,			*Ft.*	*In.*	*Thickness. Ft.*	*In.*
At	36	Splint Coal,		2	0	4	6
Further	7	Coal Rough,	Coal,	2	0	5	3
			Band,	0	1		
			Coal,	0	10		
			Band,	1	2		
			Coal,	1	2		
Further	7	Beefy Coal,				4	0
Ditto	14	Diamond Coal,				4	2
Ditto	5	Jewel Coal,				4	0
	69					21	11

At Sheriff Hall the dip to the south-east is about one in twelve, which gradually lessens, and the stratification, on passing the river Esk takes an opposite rise analogous to the lying of the surface, till it reaches the high ground in the neighbourhood of Fuffett, where part of the upper beds of Coal, are as it were, washed off. The lower ones continue to undulate through the valley of the Tyne, until they either successively crop out or terminate against the secondary stratification which stretches up the country from the southward of Dunbar.

Underneath the North Green Seam, and at the distance of about 40 fathoms ranges a bed of Encrinal or Carboniferous Limestone, about 30 feet in thickness. On the northern crop it is wrought extensively in the Gilmerton estate, and at so great a depth below the surface as 30 fathoms, which renders it necessary to leave proportionate pillars (averaging about one-tenth) for the support of the roof; the works are drained by a steam engine placed upon a perpendicular shaft upwards of 30 fathoms in depth. But to return to the Colliery.

Gilmerton Colliery is remarkable as the deepest winning that has ever been made upon the Edge Coals, or, I believe, upon any other Coal in Scotland, and the first in which a Rail-way has been introduced for conveying the produce of Edge Coal workings to the pit bottoms.

The following account of the strata sunk through was furnished by Mr. Marshall, the lessee.

AN ACCOUNT OF STRATA SUNK THROUGH IN GILMERTON ENGINE PIT.

	Fth.	*Ft.*	*In.*
Hard Limestone Blaes or Shale,	8	0	0
Soft Coal Blaes,	4	0	0
Vexam Coal,	0	1	4
Soft Blaes,	1	0	0
Thin Coal,	0	0	6
Freestone,	2	0	0
Soft Blaes,	0	3	0
Freestone,	9	0	0
Soft Blaes,	0	3	0
Hard Limestone Blaes,	2	0	0
Thin Seam of Coal,	0	1	0
Freestone, very hard,	5	0	0
Soft Blaes mixed with Iron Stone,	6	0	0
Thin Coal,	0	1	2
Freestone,	2	0	0
Soft Blaes mixed with Iron Stone,	5	0	0
Coal,	0	1	2
Red Freestone, very porous,	26	0	0
Hard Limestone Blaes,	23	0	0
Total	96	1	2

This stone forms the bottom of engine pit, and from which point is driven the level into the Coal. *See* the annexed Profile, page 169.

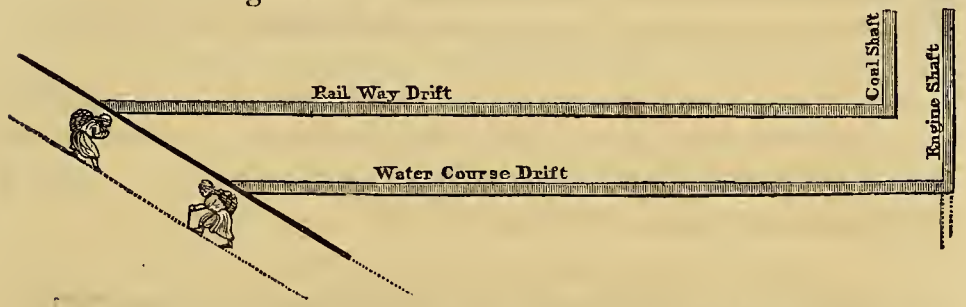
HORIZONTAL MEASUREMENT ALONG DRIFT.

From bottom of Engine pit in Limestone Blaes, to Limestone bottom			13	0	0
Further in, Limestone,			1	2	0
Ditto, Soft Blaes,			6	4	0
Ditto, Parrott Coal,	1	0	0	1	4
Ditto, Rough Coal,	0	4			
Ditto, Freestone,			0	2	0
Ditto, Fire-clay,			0	0	6
Ditto, Hard Freestone,			4	0	0
Ditto, Soft Blaes,			4	0	0
Ditto, Hard Freestone,			5	3	0
Ditto, very Soft Blaes, or Roof of Coal,			7	0	0
Ditto, Parrott Coal,	1	4	1	4	4
Ditto, North Green Seam,	9	0			
Total Horizontal Drift,			43	5	2

In 1829, the engine pit after two years and a half of labour was completed to the depth of 96 fathoms, but the Coal being found considerably deeper than expected, and the power of the engine being well nigh

outmatched, a stone mine was driven out towards the full rise, and cut the Coal at 80 yards distance,

The principal Coal Shaft 10 yards apart from the engine pit was stopped at 88 fathoms, and a similar stone mine 100 yards long also run out to the Coal, and from which point Rail-way passages are driven water-level-wise right and left.



The Coal is about 5 feet thick, and as it lies at an angle of 40° with the horizon, it is quite impracticable to use wheel carriages in the conveyance of the Coals either from the rise or the dip, they are therefore *borne* upon the backs of women and girls from all the working places apart from the main water levels.

The women, who carry full loads, provide themselves with wicker creels, which are fitted to the back, and steadied by a leathern strap passing round the forehead; the smaller boys and girls carry single blocks of Coal proportioned to their strength and expertness; the regular load of a good bearer in the Edge Seams, is from 12 to 14 stones, and in the Flat Coals from 16 to 20 stones,

The bearers find their own lights and creels, and are hired at from 10*d.* to 14*d.* per day, by such of the hewers as are not fortunate enough to possess wife, sister, or daughter, the necessity of which tends to constant and early intermarriages amongst each other, and is attended with utter want of domestic comfort.

The difference of the labour in bearing up or bearing down is by no means so great as might be expected, for after being a while accustomed they are unwilling to change from one to the other.

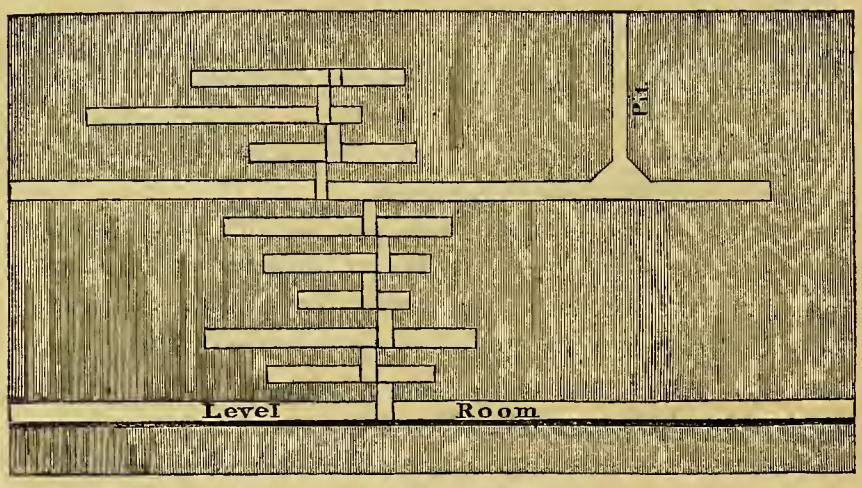
In order to enable the bearers to traverse these steeps, small steps or

niches are cut in the Coal seat with every here and there a passing place. Their lights consist of small oil lamps hooked into the front of their caps; their dress the coarsest woollen, and they generally use a very short stick as a steadier to their precarious footing.

The collier has for hewing, bearing to the main level, filling into the rail-road tubs, and conveying to the shaft bottom, a distance of about 500 or 600 yards, *great Coal*, 3*s.* 4*d.* per ton, and *small Coal*, 1*s.* per ton.

As the wheel carriages are confined to the level of the Coal pit bottom, the Coals have thus to be *borne* from the engine pit levels, as well as from the rise workings, between which points is comprised a distance of 150 yards, as shewn in the annexed plan.

PLAN OF THE WORKINGS LOOKING FROM DIP TO RISE.



In this manner 80 to 100 tons per day are regularly worked, the great Coal selling for 7*s.* 9*d.*, and the small 2*s.* 6*d.* per ton, nearly all the former being led in carts to Edinburgh.

The bearing system so peculiar to the Coal Mining of Scotland, seems to have originated in the working of these Edge Seams, and when the difficulty of applying any other means comes to be considered, necessity would appear to plead strongly for such a practice, especially at a period

when the means of sinking to the deep Flat Coals was so imperfectly understood, but it is difficult to account for a system so replete with poverty, slavery, and demoralization, and moreover so destitute of real economy, being persisted in throughout the neighbouring Flat Collieries. In Sheriff Hall and Edmonstone, not less than 250 or 300 bearers are constantly employed, in a Coal lying at about one in fifteen, and most favourably circumstanced for the adoption of Rail-roads. In the Marquess of Lothian's Collieries, south of the Esk, and many others, the Coals are borne to the very surface by means of winding stairs fixed in the pit shafts. It must at the same time be observed, that tram-roads are beginning to find an introduction, and which it is to be hoped for the sake of humanity, will rapidly supersede, for the most part, so unbecoming a species of labour.

It is somewhat remarkable, that this immense mass of Coal should be entirely of the bituminous quality, viz. Splint and Cubical, and scarcely one single specimen having any tendency to cake.

Before concluding this paper, I wish to mention as a corroborating fact of the Edge Coal underlying the Flat Coals of Sheriff Hall, that a part of the Marquess of Lothian's ground contains a Parrott Coal, similar to that in the Edge suite, and dissimilar to any thing in Sheriff Hall, also that the Limestone is found cropping out beyond the south-eastern ascertained Coal. I am not sufficiently acquainted with the Coal-field south of the Esk, to attempt a classification, but I have little doubt it may be proved to correspond with the Coal and Limestone on the northern outcrop.

In further illustration of the subject, I have annexed a rough Map of the district, to which this paper chiefly applies (Plate 15), and also a Plan and Section of the operations of Gilmerton Colliery (Plate 16).

No. XIX. *On the Red Sandstones of Berwickshire, particularly those at the mouth of the River Tweed. By* Henry Witham, of Lartington, Esq., F. G. S., &c.

Read, September 20, 1830.

In reading over the able address delivered by the President, Professor Sedgwick, to the Geological Society of London, on the 19th of February last, I observed the following passage:—"The association of the Coal and Mountain Limestone of Northumberland has not been well explained. The great corresponding deposits of Cumberland are undescribed, nor does it appear in our published works, that Coal is found alternating in the north of England, with all parts of the Mountain Limestone group: and that beds of Coal are worked in several places, resting upon the Transition Slates, and surmounted by the whole Limestone series." Being at all times anxious to promote the views of the distinguished and enlightened President, of our parent Society, I have with much pleasure, devoted a considerable portion of my time to the examination of many deposits in Berwickshire; but in particular that of its Red Sandstones, which may probably throw some light upon a group of rocks, with which they were supposed to have little or no connection.

I feel some difficulty in entering on the task I am about to undertake, as by the following observations, I may be probably found to entertain views altogether different from those, who have written and expressed their opinions upon these Red Sandstones, but as our worthy President affirms in the same address, "we have nothing to fear from the results of our enquiries, provided they be followed by the laborious but secure road of honest induction; in this way we may rest assured we shall never arrive at conclusions opposed to any truth, nay rather, that new discoveries will ever lend support and illustration to things

which are already known, by giving us a larger insight into the universal harmony of nature," I shall proceed.

It has long been matter of doubt and dispute amongst many able Continental, as well as British, Geologists, whether the Red Sandstone, found at and near the mouth of the river Tweed, belongs to the old or new Red Sandstone series. My early observations, I must confess, biased me much in favour of the latter, and this opinion was by no means shaken by the repeated examinations I had made in Caithness, Ross-shire, Angus-shire, Kincardineshire, Dumfries-shire, and the North of England, where the undoubted new Red Sandstone is acknowledged to exist. Why, therefore, when the external characters of the Tweed and Berwickshire deposits are so similar to those above named, any doubt can be entertained, I shall endeavour by the following remarks to explain.

Although in these observations I wish to confine myself as much as possible within the limits of Berwickshire, yet in order to make the point, I wish to establish, more clear and intelligible, I trust, I may be excused introducing a few remarks made by my friend Mr. Francis Forster, upon a part of the northern coast of Northumberland.

"At Fenwick, nine miles and a half south of Berwick, the Carboniferous Limestone appears, and is quarried to considerable extent. It is accompanied by a bed of Red Sandstone, and the latter is brought up by a fault, about half a mile south of Fenham, and its vicinity indicated by the red braes occasionally rising from the sand, for two miles further south. Again, at North Sunderland, above the 20-feet Limestone (so extensively quarried and sent to all parts of Scotland), I found, and was much struck with, this Red Sandstone. Its position, however, immediately above, and conformable to, a bed of Carboniferous Limestone, 20 feet thick, with a six-feet seam of Coal, 18 fathoms below it, completely settled the point as to the order to which it belongs. *See* Figs. 1 and 2.

Fig. 1.

SECTION AT NORTH SUNDERLAND COLLIERY.

Dip of the Strata N.E. to N. varying from 12° *to* 18°.

	Fth.	Ft.	In.
Carb. Limestone	0	4	0
Coal	0	0	8
Freestone	11	0	0
Bituminous Shale	4	1	4
Coal with a 12 in. band of Shale	4	0	6
	17	0	7

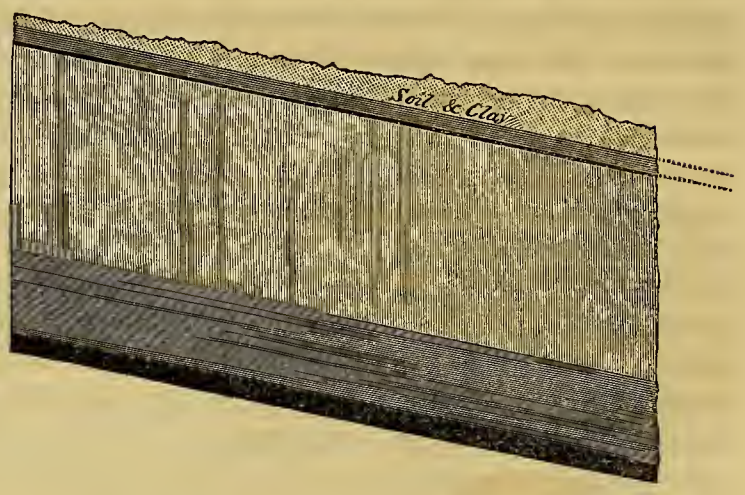
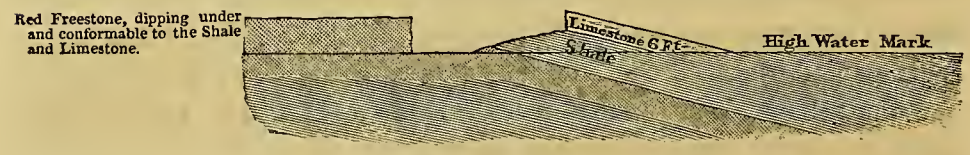


Fig. 2.

SECTION OF THE STRATA ON THE SEA SHORE A QUARTER OF A MILE TO THE DIP OF NORTH SUNDERLAND COLLIERY.



"Again, about a mile and three quarters north of Goswick, or four and a half miles south of Berwick, a strong bed of massive granular Red Sandstone (precisely similar to that under Berwick Castle, and in the cliffs east of Scremerston,) overlies a bed of Limestone, 20 feet thick. These strata dip to the S. W. at an angle of 30°, and after emerging from the sea, are very shortly concealed amongst the Sand and Sandstone hills forming the coast for three or four miles further south.

"At a point* near a lime-kiln, under Major Johnson's house, about a

* *See* Table of stratification between Scremerston and Berwick, page 176.

mile south of Berwick, a thick bed of Shale is seen dipping at an angle of 43° in the direction of S. 84 E. A few yards beyond, a Limestone crops out, overlaid by a thick dark Shale 9 feet thick. This bed is overlaid by a strong bed of Red Sandstone forming the cliffs extending towards the Tweed. Here a remarkable cliff is formed by the cleavage of one of these great Sandstone beds, running in an unbroken plane, from its top into the sea, at an angle of 44°, its water level bearing or drifting towards the light-house at Berwick Pier-head. These Sandstones alternate with at least three Limestones and a variety of Shales, clearly establishing that they belong to the Mountain Limestone group."

One of the beds of Limestone near Scremerston, presents a singular example of extreme contortion (*see* Fig. 3), the disturbing force would appear here to be very local as the beds within 20 yards are not affected.

Fig. 3.

As some Geologists have entertained rather singular ideas respecting these alternating Limestones, I beg to state that the following fossils occur in them in considerable abundance :—*Encrinites, Madreporites, Terebratulæ, Spiriferæ, and Productæ.*

To make the proper position of the Red Sandstones appear still more clear, I subjoin a table of the stratification of the coast of Northumberland, from the Red Sandstone rock of Scremerston Mill-house, to the great formation of the Red Sandstone between Scremerston and Berwick. This table shews the alternation of these beds to continue to the Tweed.

TABLE.

Succession of the Strata of the Coast of Northumberland, from the Red Sandstone Rock of Scremerston Mill-house, to the great Formation of Red Sandstone between Scremerston and Berwick.

Sandstone (Red), dip 26 degrees.
Shale, dip 34 degrees.
Limestone.
Shale.
Limestone, dip 30 degrees.
Shale.
Sandstone, dip 24 degrees.
Shale.
Limestone.
Shale, dip 32 degrees.
Sandstone, dip 36 degrees.
Shale, with Girdle Beds, and Iron Stone.
Limestone, dip 36 degrees.
Shale.
Limestone, dip 38 degrees.
Girdle Beds.
Limestone.
Shale.
Sandstone, with *Variolaria*.
Shale.
Sandstone.
Shale.
Sandstone.
Shale.
Sandstone, and Girdle Bed.
Shale.
Limestone.
Sandstone (Red).
Shale.
Sandstone (Red).
Shale.
Sandstone, dip 36 degrees.
Sandstone of a deep red colour, of great thickness, dip in one situation 46 degrees, direction north and south. This stratum appears to continue all the way to Berwick. A Red Sandstone, apparently one of the beds of this rock, is seen cropping out under Tweedmouth Church, its direction nearly north and south, and dip 30 degrees east, this appears to be the same rock upon which Berwick Castle stands. The dip of the beds below Berwick Castle, is 48 to 50 degrees east, and the direction north and south.

By this digression, the various alternations of the Red Rock with the Shales and Limestones from Fenwick, nine and a half miles south of

Berwick to the river Tweed, immediately opposite to the Castle rock, will be apparent.

I shall now proceed to describe the rocks on the north side of the river Tweed. Beginning at the west end of the Castle cliff at Berwick, we find a very fine white-grained Limestone, dipping rapidly to the east, and overlaid by a bed of Sandstone, 12 feet thick, of an unusually white colour, apparently partially decomposed (probably by proximity to a Basaltic Dyke). The Limestone again is overlaid by a Sandstone, having the characters of a Coal Sandstone. This is about ten feet thick, and is overlaid by a seven or eight feet bed of peculiar nodular Limestone, striated with beds of White and Red Shale, on it reposes a bed of Sandstone, which is overlaid by a very ferruginous Sandstone of considerable thickness. Again, under the eastern ramparts is a soft Red Sandstone, dipping east 55°, and about 80 yards further north, is a bed of Limestone several feet thick, and overlaid by a very thick bed of Shale. At a short distance, is a two-feet Limestone, and eight or ten yards further are two beds of Limestone, overlaid by a thick bed of Shale, and dipping east 64°. Twenty yards further is another thick bed of Limestone, where it and the Shale are so singularly contorted, as to render it probable that the same beds are repeated in this part of the cliff. The representations (in Figs. 4 and 5), give but a

Fig. 4.

SECTION OF A SLIP DYKE, A DOWNCAST TO THE SOUTH, ABOUT HALF A MILE NORTH OF BERWICK.

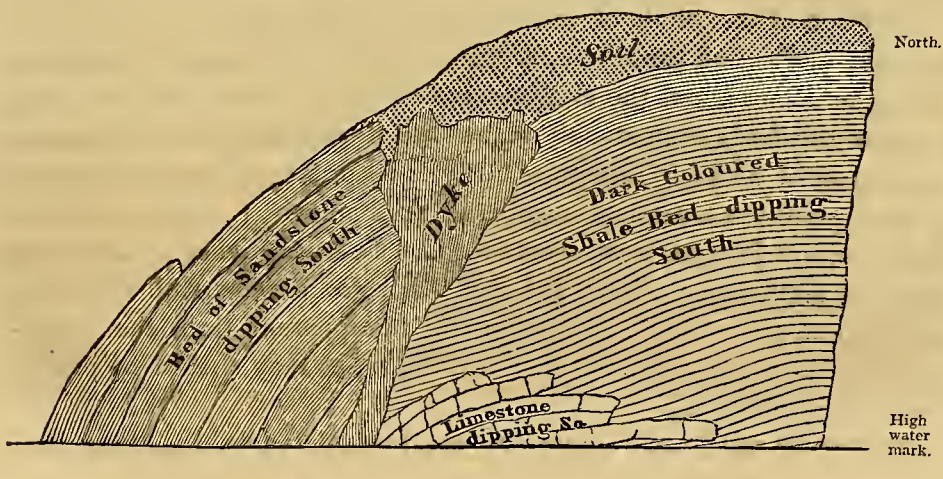
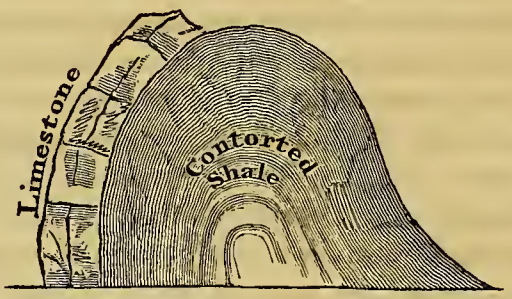


Fig. 5.

A CONTORTION OF THE STRATA BETWEEN THE RAMPARTS AND THE PIER.



feeble idea of the two contortions between the east rampart and the pier. Thus far we may perceive the alternations of the Limestones, Sandstones, and Shales. Immediately to the north, the Limestone becomes nearly horizontal, the influence of the trouble ceasing to have any effect.

By the above observations it would therefore appear, that this highly ferruginated Sandstone alternates with the Limestones and Shales, which are seen cropping out on the north side of the river Tweed, close to the town of Berwick, as well as to the south, and, in my opinion, clearly establishing, that, instead of the Red Sandstone, found in the neighbourhood of Berwick, being a member of the new Red Sandstone series, it is here a decided subordinate member of the Mountain Limestone group.

A section of the whole of the coast of Northumberland, would show the beds of the Coal formation, reposing upon the Mountain Limestone series; or if we adopt the classification of Coneybeare and Phillips, many of the beds immediately below the Coal formation will have to be considered as their Millstone Grit, and Limestone Shale formation. At what point the Coal-field terminates on the coast, it may be difficult to decide, but I presume we must take it to be where the first Limestone makes its appearance. That the Red Rocks of Scremerston belong to the Mountain Limestone formation will be apparent from the foregoing observations, but how far down in the series they should be placed is not yet ascertained.

Proceeding northward along the coast of Berwickshire, these Red

Rocks may be traced. They are found alternating with Shales and Limestones, containing many of the most characteristic fossils of the Mountain Limestone. I must here observe, that between Berwick and Ross considerable seams of Coal have formerly been worked. The most singular distortions have taken place by the protrusion of the Transition rocks of the Lamberton Hills, which has raised them to a perpendicular position, and even caused them to bend over, as will be seen by Figs. 6 and 7.

Fig. 6.
ONE MILE SOUTH OF ROSS.

Red Sandstone, lower part, a Conglomerate, having Shale and other Limestone Beds alternating.

Fig. 7.
ROSS.

Sandstones, Limestones, and Shales.

At a point one mile south of Ross, Red Rocks are seen in contact with the Greywacke. Many of the beds in the lower part are conglomerates which I take to be of the old Red Sandstone.

Again, on the north side of St. Abbs' Head, I observed many similar alternations with this Red Rock. A blue Limestone, containing organic remains, is worked at Thornton-lough, dip N. E. Further north, Limestone is seen at Skaterow, which also dips to the N. E., and at the Duke's kiln quarry, two miles south of Dunbar, is seen a Limestone 13 feet thick, with thin Shale beds in it, reposing upon a seam of Coal from 8 to 12 inches thick, all these beds being above the last mentioned red rock.

Thus it would appear, that along the whole range of coast from Fenwick, nine and a half miles south of Berwick, to the neighbourhood of Dunbar, this Red Rock, although so much resembling the new Red Sandstone, is evidently a subordinate member of the Mountain Limestone group.

Having now ascertained the relative positions of the rocks along this length of coast,* it became necessary to examine the rocks further up the country, to ascertain whether they lay in similar positions with respect to the Limestones and Shale beds. For this purpose, therefore, I started at Carfrae-mill, two and a half miles north of Lauder. I here found in the bed of a brook, the Red Sandstone ; although in the immediate neighbourhood of Greywacke, I was unable to find it reposing upon it. I cannot, however, entertain a doubt that it does so. From Lauder to the neighbourhood of Greenlaw, I in vain looked for any exposed rock, the whole country in this neighbourhood being covered with a thick diluvial deposit, much ferruginated. At the bridge of Greenlaw, there is a beautiful section of the Red Rock, 12 feet thick, seen rising 14° in the direction of north, 65° east. From Greenlaw, creeping round the southern front of the Transition range of the Lammer-muirs, at a short distance is thrown up a Felspar Porphyry. Advancing to the east you come into the neighbourhood of Polworth where again is seen the Red Sandstone accompanied with its conglomerate.

In the neighbourhood of Dunse, about a mile south of the town, you have a fine display of a light-coloured Sandstone, filled with vegetable impressions. The bed is 23 feet thick of solid stone. It dips towards the south at a trifling angle.

At St. Helen's, two miles east of Dunse, beds of shivery Sandstone and Shale, containing nodules of Ironstone, occur.

Below Churnside Bridge, are found several thin beds of very compact Limestone, of a blue colour, alternating with Sandstone and Shale, and forming bold cliffs. Near the bridge is a thin bed of the Red Rock. At Eddington-mills, and Blue Braes, the Red Rock again presents itself, in beautiful escarpments, and is of great thickness. It contains veins and nodules of fibrous Gypsum, and dips at an angle of 16° W. S. W.

Again, at Allanbank-mill, near the junction of the rivers White and Black Adder, in a thick bed of Shale, (belonging undoubtedly to the same series of beds which is seen near Churnside Bridge, and Edding-

* In a future paper I hope to be able to trace the relative positions of these rocks in Haddingtonshire, and Midlothian. Mr. Hay, of Spots, is now boring for Coal at Eastburn about two and a half miles south of Dunbar.

ton-mill, below the Red Sandstone, and conformable to it), are found numbers of stems of Gymnospermous Phanerogamous Plants, also *Sigillariæ*, *Lepidodendræ*, and leaves of Ferns. This locality is about seven miles from Lennel-braes, where plants belonging to the same class are to be found in great abundance.

There, therefore, appears no doubt, that were the Shales of this district properly examined, many of these ancient vegetable fossils might be found. This, I trust, will encourage gentlemen living in the neighbourhood of other Mountain Limestone groups, to examine attentively these apparently fruitful deposits. Many of the fossils occurring here, as well as at Lennel-braes, are partly mineralized with Iron Pyrites. This substance appears to decompose, upon exposure to the atmosphere, and the sulphuric acid uniting with Lime produces beautiful crystals of Selenite, which are found in abundance at both places.

Three miles above Coldstream, at a place called Hindley-top, are to be found many thin alternating beds of Shale and Blue Limestone. In one of these Shale beds, Gypsum occurs. The fibrous variety, in layers about half an inch thick, and the common, in nodules of a flesh red colour, having beautiful crystals of Selenite in them.

In order to ascertain the position of the rocks on the south side of the river Tweed, twelve miles from the coast, and with reference to those on the north of that river, I proceeded up the bed of the river Till, where I found the rocks rising to the N. N. W. at an angle of about 8° until I came within the bounds of the eruptive force of the Cheviots, when they appear to rise to the west. This alteration of dip, caused by the proximity of Transition rocks, I also found to be the case generally at the base of the Lammer-muir hills.

In proceeding up this river, a short way above Heaton-mill, I observed a singularly beautiful Basaltic Dyke, containing much Chlorophæite. This Dyke runs from east to west, and I have the satisfaction to say it has been traced by my friend Mr. Milnes, of Milgraden, from a short way below Coldstream, where it appears on the south side of the Tweed, opposite to Lennel House. Here it is from 8 to 10 feet wide. It then runs directly east to Milkington, where it increases in breadth to

from 15 to 18 feet. At Heaton-mill its breadth is near 24 feet, and at Duddoe it widens out to 30 feet. It is seen farther east, and worked at Millalloes or Morcelles. Neither Mr. Milnes nor I having had an opportunity of examining it in this spot, we were unable to make any remarks upon it; suffice it to say, it is believed to extend to the neighbourhood of Holy Island, and may probably be the same Basaltic Dyke seen from the turnpike road leading from Belford to Berwick, a short distance south of Haggerston.

There is another Basaltic Dyke running in a parallel direction, a short way further south. It is worked at Halidon-hill, and passes Etal colliery, but Mr. Milnes has been unable to trace it any further.

The rocks, therefore, after they cease to be disturbed by their proximity to the Cheviots, the whole way from Shoreswood and Morton, (which I look upon as the higher portions of the Mountain Limestone group,) rise at various angles towards the N.W., and appear to me to demonstrate, that the Red Rocks, which accompany the Shales and Limestones, from this quarter to the Lammer-muir hills, are all subordinate beds of this Mountain Limestone group.

The result, then, of these repeated journies over the ground and repeated examinations, has been to produce a firm conviction on my mind, of what seemed to me at first more than problematical; namely, that the Red Rocks in the neighbourhood of Berwick, and also those seen upon the Tweed, the Black and White Adder, and in other localities of this district, are not the new Red Sandstone, but subordinate members of the Mountain Limestone series.

In a paper written by me, and published in the *Annals of Philosophy*, July last, on the Vegetable Fossils found at Lennel-braes, near Coldstream, I made use of the term "Coal Formation," there being beds of this combustible matter in this series. By some this is looked upon as correct, still as these rocks all lie below the Coal-field proper, I think it more correct to class them as a Mountain Limestone group. South of Berwick in this formation, several good beds of Coal are worked. How far the subordinate members may prove fruitful in this useful commodity must at present remain matter of great uncertainty.

I cannot help now observing how cautious we ought to be in pronouncing, from mineralogical characters alone, the nature of any of these Sandstones. Nothing but exact observation upon position, and upon their alternation, can justify our deciding upon the series to which they properly belong. The similarity to each other, in hand specimens, between many of the rocks of this formation and the proper new Red Sandstone, is often so striking, that the most experienced observer, without such precautions, must be liable to very gross mistakes.

By this investigation, two features are exhibited in these subordinate beds of the above-named formation, which before were supposed only to exist in much more recent deposits.

First, accompanying the usual fossils belonging to the class Vascular Cryptogamia, viz. the *Sigillariæ*, the *Lepidodendræ*, the *Stigmariæ*, and *Equisetæ*, so common in these measures, you have in this Field, embedded in Shale, great abundance of Gymnospermous Phanerogamous plants. The two localities already observed are seven miles apart, and I cannot entertain a doubt, that upon the banks of the White and Black Adder and many other localities, were workings to be carried through these Shale beds for any purpose, great abundance of these singular fossils would more than repay those interested in such novel discoveries.

Secondly, the presence of Gypsum in the Sandstones and the Shales, containing beautiful crystals of Selenite, has, in deposits so low down, hitherto, I believe, escaped notice.

My attempt, therefore, to ascertain the true position of the Red Rock of Berwickshire leads me to think, that there cannot remain much doubt that the Mountain Limestone series extends from the point where the first Limestone appears on the coast of Northumberland, to the Transition range of the south of Scotland, and that beds of Coal have been worked near Ross, lying immediately upon the Greywacke, and are now found a few miles south of Dunbar, in a similar position: how far north this Mountain Limestone group may extend, will, possibly, at a future period, be the subject of another paper.

No. XX.—*An Account of the Explosion which took place in Jarrow Colliery, on the 3d of August last. By* John Buddle, Esq.

Read, October 18, 1830.

It seldom happens that the immediate causes of those fatal explosions, which so frequently occur in the Coal-mines of this country, can be clearly ascertained; as those individuals, who alone could explain them but too frequently fall victims to their destructive effects.

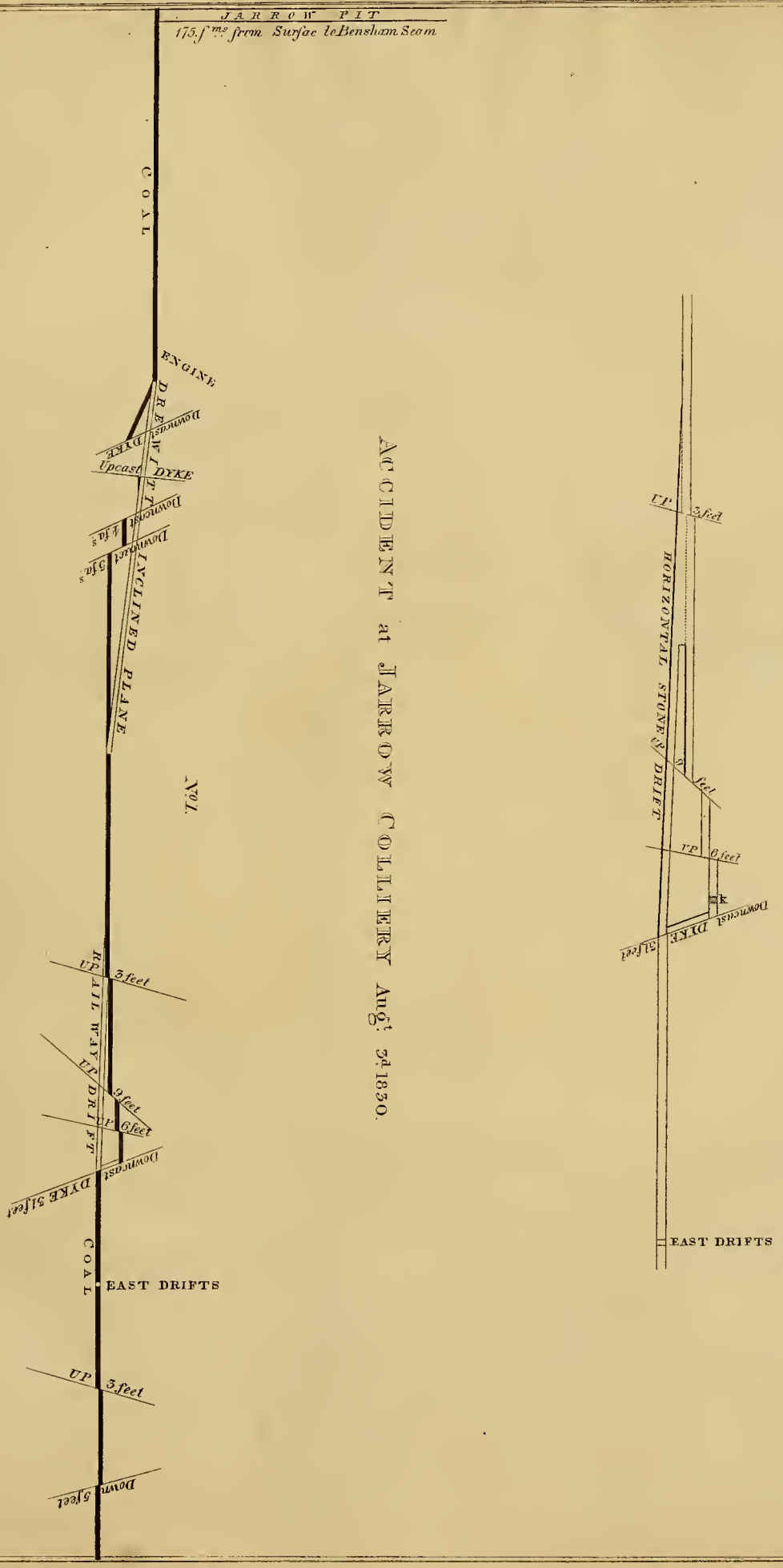
The proximate causes are, however, well known; but before I explain the nature of them, it may not, perhaps, be deemed irrelevant to state the general circumstances of our fiery collieries.

Those collieries, to which the appellation "fiery," is given, are such as abound in inflammable air, in a greater or less degree. The inflammable air is evolved from the Coal, in the working seams, or from seams lying above, or below, those which are in work.

The inflammable air thus evolved, is either immediately diluted below the explosive point, and carried away by the circulating current of atmospherical air, employed in ventilating the working seams; or it accumulates, in any fissures or cavities which may happen to be in the roof or pavement of these seams, or in the fissures of the Coal.

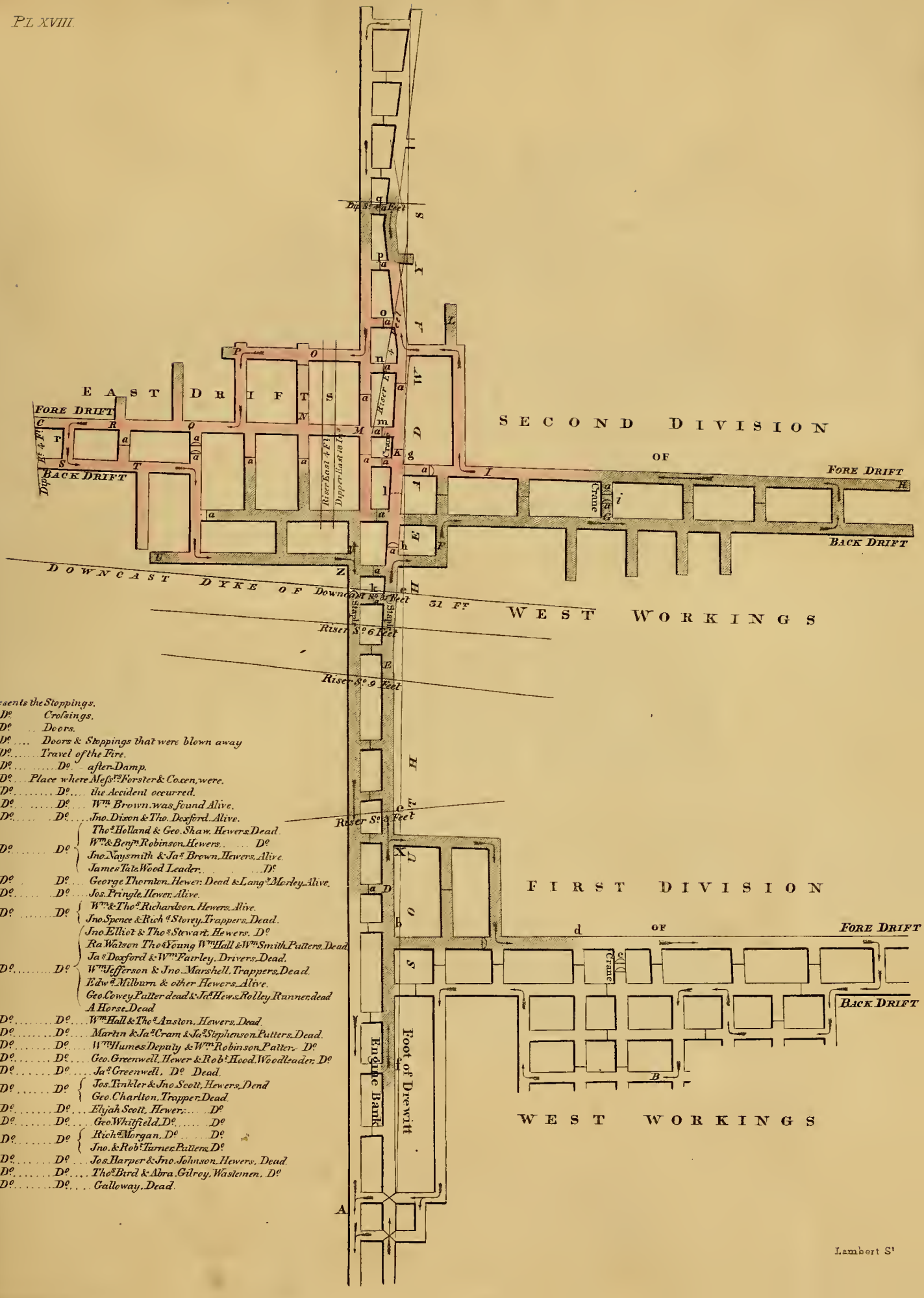
The state of the atmosphere, has great influence on the discharge of the inflammable air from the Coal in the ordinary workings of a colliery; its discharge being materially controlled, and regulated by the various degrees of density of the atmosphere. As, for example, if the ordinary ventilation of a pit's workings, should only be just adequate to the dilution of the quantity of inflammable air evolved, below the firing point, when the barometer stands at 30 inches, it would become quite inadequate, whenever the barometer falls; and on the contrary, if the

ACCIDENT at JARROW COLLIERY Aug.t 3.d 1830.



Collard Sculp.t

PL XVIII.



Represents the Stoppings.
Do Crossings.
Do Doors.
a Do Doors & Stoppings that were blown away
Do Travel of the Fire.
Do Do after-Damp.
B Do Place where Messrs Forster & Coxen, were.
C Do Do the Accident occurred.
D Do Do Wm Brown, was found Alive.
E Do Do Jno Dixon & Tho Dexford Alive.
F Do Do
- Thos Holland & Geo Shaw, Hewers Dead.
- Wm & Benjn Robinson, Hewers, Do
- Jno Naysmith & Jas Brown, Hewers, Alive.
- James Tate Wood Leader, Do

G Do Do George Thornton, Hewer Dead & Langs Morley Alive.
H Do Do Jos Pringle, Hewer Alive.
I Do Do
- Wm & Thos Richardson, Hewers Alive.
- Jno Spence & Richd Storey, Trappers Dead.

K Do Do
- Jno Elliot & Thos Stewart, Hewers, Do
- Ra Watson Thos Young Wm Hall & Wm Smith, Putters Dead
- Jas Dexford & Wm Fairley, Drivers, Dead.
- Wm Jefferson & Jno Marshall, Trappers Dead.
- Edwd Milburn & other Hewers, Alive.
- Geo Cowey Putter dead & Jas Hewes Rolley Runner dead
- A Horse Dead

L Do Do Wm Hall & Thos Anston, Hewers, Dead
M Do Do Martin & Jas Cram & Jas Stephenson Putters Dead.
N Do Do Wm Humes Deputy & Wm Robinson, Putter, Do
O Do Do Geo Greenwell, Hewer & Robt Hood, Woodleader, Do
P Do Do Jas Greenwell, Do Dead.
Q Do Do
- Jos Tinkler & Jno Scott, Hewers, Dead
- Geo Charlton, Trapper Dead.

R Do Do Elyah Scott, Hewer, Do
S Do Do Geo Whitfield, Do Do
T Do Do
- Richd Morgan, Do Do
- Jno & Robt Turner, Putters, Do

U Do Do Jos Harper & Jno Johnson, Hewers, Dead.
V Do Do Thos Bird & Abra Gilroy, Wastemen, Do
W Do Do Galloway, Dead.

barometer should rise, the evolvement of inflammable air, would be much diminished. Hence it is, that we frequently find some of our Coal-mines in an explosive state, when the barometer is low, while the presence of inflammable air, is scarcely perceptible when the atmosphere is in a very dense state.

The cause of this fluctuation in the discharge is evident. When the density of the atmosphere is just equal to the elastic force of the gas, contained in the pores, or fissures, of the Coal or adjoining rock, the two fluids balance each other. But whenever the density of the atmosphere is diminished, the equilibrium is destroyed, and the elastic force of the gas preponderates.

We observe, however, that the discharge of the gas generally precedes the fall of the barometer, by a brief interval, probably owing to the more delicate nature of the balance.

I shall now proceed to explain the *proximate* causes of explosion.

First—by a change in the density of the atmosphere, as indicated by the fall of the barometer.

In this case, the circulating current of atmospherical air, becomes mixed to the point of explosion by the increased discharge of inflammable air, as already explained, and ignites at the first flame that may happen to be within its range. Explosions have happened from this cause, by the inflammable current igniting at the furnace placed at the bottom or top of the upcast shaft, for carrying on the ventilation—I have known them happen in both ways.

This case does not, however, very frequently occur, as the *over-loading* of the current of atmospherical air, seldom takes place so suddenly as to elude the vigilance of the persons in charge of the mine. Yet I have seen the whole circulating current of a pit's workings rendered explosive in the course of fifteen or twenty minutes.

This was the cause of the accident in the A pit, Bensham seam, Wallsend colliery, on the 23d October, 1821, when fifty-two lives were lost. The workings of this pit were subject to be charged to the firing point, in the manner already described, but accidents had always been avoided by the vigilance of two young men—the overmen of the pit.

It was, however, deemed prudent, in consequence of the dangerous nature of the pit, to place it under the care of the most experienced overman in the colliery. In a short time afterwards, this fatal accident happened, but as the overman, together with his deputies, and nearly all the people who were in the pit at the time perished, the immediate cause of the accident could not be distinctly ascertained. We had, however, very strong presumptive proof, that it had been occasioned by the too great confidence of the overman in his own judgment, and that he had not given the usual alarm, "*put out the lows,*" in due time. At the moment of the accident, I observed the barometer to be standing at 28·8 inches.

Second—by the accumulation of the inflammable air in the threads and fissures of the roof and pavement.

This case rarely occurs, except in a Sandstone (Post) roof, or in a pavement formed of a stratum of coarse Coal, or below which, at no great depth, a thin seam of Coal lies.

Sandstone roofs are subject to fissures of various sizes and extent, called *threads* and *gullets* by the colliers—the larger ones being called gullets. These fissures, which run generally in a vertical direction, frequently communicate laterally by *partings* or fissures to a considerable extent—so that the Sandstone roof of a seam of Coal abounding in inflammable air, may be considered as a sort of *cellular* gasometer, of vast magnitude, which receives the inflammable air, as it is evolved from the Coal below, far beyond the limits of the workings of a pit. This natural gasometer retains, or discharges its contents, according to the various changes in the density of the atmosphere, and produces the same effect precisely, as is described under the first cause. The only difference is, that in the latter case, the discharge is generally more sudden and copious.

Backworth has been more subject to this cause of danger, than any other colliery under my inspection ; and has, in consequence, been subject to more sudden transition, from a state of safety, to a state of danger, and *vice versa*. Of late, however, since the working out of the Coal pillars commenced, we have been much less subject to this

casualty, which I attribute to the escape of the gas upwards, through the fractured strata. The breaking of the strata, by the working of the pillars below, is plainly proved by the sinking of the ground at the surface, immediately above the places where the Coal has been extracted.

It is generally observable after a discharge of inflammable air, from the fissures in the roof, on the falling of the barometer, that, on its taking to rise again, the discharge of inflammable air not only ceases, but that a strong in-draught of the atmospherical air immediately ensues. I have frequently placed a candle at the orifices of the fissures, on the rising of the barometer, and generally found the flame drawn in with considerable force.

Third—by cavities, or large fissures, which do not seem to have any outlet.

This may be considered the most dangerous case, as it frequently happens that a large quantity of gas bursts out from those cavities, which occur in the roof and pavement, as well as in the Coal. When they occur in the latter, it generally happens where the seam is intersected by a "Hitch," or small Slip Dyke—or at the fissure of a large Slip Dyke.

The great danger in this case arises from the suddenness and great force of the eruption, without giving sufficient warning for the escape of the colliers, or for allowing the persons in charge of them time to adopt the necessary measures of precaution. Many accidents have happened from this cause, but there have also been innumerable instances of escape from it. The technical name adopted by our colliers for this sort of occurrence, is "a bag of foulness."

The explosion of the I pit, Washington Colliery, on the 20th of November, 1828, was occasioned by "a bag of foulness" breaking down from the roof of the air-course *board*, behind the workmen—which, at the same time, stopped the ventilation, by the fall of the roof it occasioned. So that a double cause operated in this instance to occasion the explosion—the stoppage of the ventilation, and an enormous discharge of inflammable air occurring at the same instant.

The late accident at Jarrow, of which I am presently to speak, was occasioned by the bursting out of a "bag of foulness" from a cavity in the Coal.

On the day preceding, a similar burst of gas from the thill, or pavement, of the Beaumont seam, in the Fenham division of Benwell colliery, occurred. This took place very near to where the Whin Dyke, described in a former paper (read before a meeting of this Society on the 19th January)* was set through. But, happily, an explosion was prevented by the vigilance and activity of the overman and his deputy.

I shall now describe the locality of the Drewitt District in Jarrow Colliery, in which the accident occurred, on the 3d of August, in doing which I shall be aided by the Sections, Plate XVII., and Plan, Plate XVIII.

Jarrow Pit is sunk to the Bensham Seam, which is found at the depth of 175 fathoms from the surface, and lies 165 fathoms below the high-water mark of the river Tyne. The pit is only 360 yards distant from the river, on its southern bank.

The seam lies in nearly a horizontal position for 176 yards to the south of the shaft, where it is dislocated by a succession of Slip Dykes —some throwing it down, and some up, till it is ultimately settled at a depression of 12 fathoms, below the level of the bottom of the pit—making the full depth of the seam from the surface in this part 187½ fathoms. A sloping stone drift, in which the rail or rolly-way is laid, forms the principal communication between the pit, and the workings on the dip, or south, side of the Slip Dykes. The Coals are drawn up this inclined plane by a steam engine, as represented in the section, Plate XVII.

These Slip Dykes having been previously set over in the Main Coal seam, which lies 45 fathoms above the Bensham—the extent to which they depressed the latter was pretty well known, and as the seam was very fiery on the north, or rise side, of the Dykes, we concluded that it would be at least equally fiery, if not more so, on the south, or dip side, of them—especially as no workings had ever been made beyond them in that direction.

* *See* Page 9.

All requisite measures were, therefore, taken to ensure a powerful ventilation in that part of the colliery—the drifts of access through the Dykes were completed, and the working of the Coal beyond them commenced in July, 1829.

In the course of prosecuting the workings to the south, another succession of small Dykes was met with, which depressed the seam about 7 feet, and access through which, for the rolly-way, was formed by the stone drift, represented on the section.

Contrary, however, to expectation, and to the agreeable surprise of every one, scarcely any inflammable air appeared, either in the Coal or in crossing the fissures of the several Dykes. And, from that period, until within a few weeks of the accident, the workings continued in this harmless state. The presence of inflammable air having scarcely ever been discernible in any part of them.

About five or six weeks preceding the accident, a slight discharge of inflammable air from the Coal, began to appear in the east drifts—*see* Plan, Plate XVIII., which continued, with little variation, up to the time of the accident. This discharge of gas never increased to such an extent as to excite alarm, or to require any extraordinary measures of precaution, to be resorted to.

The whole tract of workings, in this district, is but of limited extent, and the distribution of the current of atmospherical air, as represented on the Plan, Plate XVIII., ensured an ample supply of cool, fresh air, and a copious ventilation in every part of the workings.

The current of fresh air was carried from the bottom of the pit along the rail-way, to the top of the Drewitt engine inclined plane stone drift—through which it continued to the west drifts at X. Here the current was equally divided into two branches—one of which ventilated the first division of west workings, and the other continued straight forward along the headways, into the second division of west workings, which it ventilated, and passing through to the face of the south headways, returned by the east workings and east drifts into the back winning headways at Z, along which it ran, and united with the first branch at A, after which the united current proceeded to the upcast shaft. The

darts upon the plan shew more distinctly the run of the current of air. I found the ventilation, at all times, in the most satisfactory state, up to the 26th July, which was the last time I viewed the workings before the accident happened. I then paid particular attention to the state of the east drifts, and could not observe any increase of inflammable air—indeed the quantity then discharging was barely discernible. And we have it in evidence, on the coroner's inquest, that matters continued in this state until within a very short time of the accident happening. Having premised so much, I shall now proceed to narrate the particulars of this accident, which has excited such a general and lively interest in the country.

This melancholy catastrophe happened on the morning of Tuesday the 3d of August last, at about twenty minutes before six o'clock.

It happened to be the "pay week,"* and Messrs. John Forster, the resident viewer, and Ralph Coxon, the under-viewer, went down the pit at five o'clock in the morning, to measure off the narrow and drift-work, which is paid by the yard. They proceeded into the Drewitt district by the rail-way, and met John Johnson, the overman, at the foot of the first west drifts, marked *b*, on the Plan, Plate XVIII. He was interrogated in the usual manner— "how are you all situated this morning; has any thing fresh occurred?" Johnson replied, that all was well, and that he had othing new, except in the east drifts. He said, his back overman, Robert Linsley, whom he left in charge of the pit the preceding *shift*, had reported, that during his shift a bag of foulness had come off, in the face of the back east drift, but it was soon exhausted, and the place became quite *clean* again.

On receiving this information, Johnson went immediately into the east drifts—he went direct into the back drifts, and, just after his arrival, the *hewer*,† who was working in the face, told him, he believed he had "pricked a *hitch*."‡ Johnson immediately examined if any inflammable air was discharging, as, from Linsley's report of what occurred a

* The custom is to pay the colliers once a fortnight—they divide the fortnight into the *Baff* and *Pay* Week.

† The collier who digs the coal.

‡ A small Slip Dyke not exceeding the height of the seam.

few hours before, he thought it most probable that a discharge of inflammable air would ensue from the fissure of the hitch. No such discharge, however, did take place, and he immediately took a pick and laid rather better than a superficial foot of the face of the hitch bare, to examine it. He then went into the fore drift to examine the state of the air, and the ventilation there; he found the former clean, and the latter powerful. He conversed with Joseph Tinkler, who was hewing in the fore drift, and Richard Morgan who was working in the back one, on the excellent state of the ventilation—little thinking, alas! how soon their doom was to be sealed—and remained with them until it was time for him to go to meet Messrs. Forster and Coxon, at the usual place of rendezvous, at the bottom of the first west drifts.

On arriving at this place, the conversation already narrated took place, and the party sat down there till Mr. Forster wrote the names of the different persons whose work they had to measure off. This only occupied a few minutes, when, contrary to their usual custom, they went, by mere accident, into the first west drifts to measure off the work in that quarter. This was most providential, for had they gone into the east drifts first, according to their usual custom, they must inevitably have perished by the explosion which ensued in a few minutes. In which case, the whole of the people, in all probability, whose lives were saved by their subsequent exertions, would also have perished.

From the point *b*, Plate XVIII., Messrs. Forster, Coxon, and Johnson went into the first division of the west workings, and had just begun to measure off the narrow work at B, when they were alarmed by a sudden concussion and whizzing in the air—the well known indications of an explosion having taken place some where. They, however, least of all suspected it to have happened in the east division of the Drewett district. Their first impression was, that it had happened in the Main Coal seam under Jarrow Slake, where the pillars are being worked. That being the only place in the colliery where inflammable air was known to abound at the time.

The place here alluded to lies about 45 fathoms above the level of the place where the explosion happened, and at more than the distance of a mile from it, in an horizontal direction.

The people working in the Slake district, although at so great a distance, and also in a distinct current of air and separate ventilation, were alarmed by the concussion occasioned by the explosion.

Messrs. Forster, Coxon, and Johnson's first care, after the atmosphere became tranquil again, was to collect all the men and boys in that division into a group at the crane *c*, and to endeavour to conduct them safely *out-bie*.* They proceeded down the fore drift with that intention, and had only got as far as the point *d*, when they met with a volume of dense hot smoke and *after-damp*, † which filled the drift from top to bottom, and threatened to put a stop to their further progress.

This satisfied them that the explosion had taken place somewhere in the workings beyond the horizontal stone drift *e e*, and it was also but too clear, that it must have proved fatal to all those who had been within its range, and that their own lives depended upon their being able to force their way through this deadly cloud. There was no time for deliberation, they threw themselves down upon their hands and knees, stuffed their handkerchiefs into their mouths, and scrambled away with all possible expedition till they reached the point *f*, at the foot of the inclined stone drift, a distance of 120 yards, where they happily met the full current of fresh air from the bottom of the pit.

Meeting with the current of fresh air at this point, satisfied them that the ventilation had not been deranged any further *out-bie* by the shock of the explosion, and encouraged them to hope that they might still be able to save the lives of some of the people at the *in-bie* end of the horizontal stone drift *e e*.

As soon as they had recovered their strength by breathing the fresh air, they began to examine into the state of the adjacent parts of the mine. They found a dense volume of smoke and after-damp issuing out of the north end of the horizontal stone drift *e e*, which was carried

* Towards the bottom of the pit, in contra-distinction to *in-bie*, into the workings.

† A suffocating vapour produced by the explosion.

through the *stenting D a*, by the current of fresh air, into the back headways, along which it was carried by the returning current of air to the upcast shaft. The air stopping had been blown out of this stenting by the explosion. At the point *D*, they found William Brown, the craneman, who had escaped from the crane *g*, lying in a state of insensibility—he was severely burnt.

It was now evident, that every one who might have escaped death, from the immediate effects of the explosion in the workings, on the *inbie* side of the horizontal stone-drift, must inevitably be suffocated, unless the current of fresh air could be immediately forced through that drift to relieve them. Not a moment was lost; the whole of the men who had escaped from the west division of the workings, with Messrs. Forster, Coxon, and Johnson, set to work with the utmost energy to collect the necessary materials, and to put up a temporary stopping in the place of that which had been demolished in the stenting *D*, *a*, *o*. In the mean time, the overman and many of the workmen from the Slake district had arrived to the assistance of Mr. Forster's party. It was highly to the credit of those people, that on feeling the shock, and ascertaining that the explosion had not happened in their own district—they flew to the shaft to ascertain where it had happened, and then joined Mr. Forster and his party without delay.

The desired effect was produced by closing the temporary stopping in the stenting, and the smoke and after-damp was so much attenuated as to enable some of the strongest individuals to push forward to the crane at *g*; but on arriving there, the smoke and after-damp were so strong, and the heat was so great, that the party were obliged to retreat immediately. And it was but too evident that none of the people who had been employed in the workings to the eastward of the crane *g*, could then be living. On their way, the party found, at the point E, John Dixon, a trapper, and Thomas Doxford, a putter, two boys in a very exhausted state, Dixon being slightly burnt. He was at the trap-door *h*, when the explosion happened, the door was shattered in pieces, one of which had got entangled in his garter, and he had crawled over all the wreck, dragging this fragment of the door with

him to the place where he was taken up. Doxford was at the crane *i*, when the explosion happened; these boys and the craneman survived.

Several attempts were then made to penetrate beyond the crane *g*, but without success, as the current of fresh air could not be urged beyond the stenting *k*, until a stopping could be placed in it. This, on account of the large space above the stone-drift, as represented on the section, No. 2, Plate XVII., being filled with smoke and after-damp, was difficult to accomplish, and caused considerable delay. But for this interruption, there is reason to believe that several more lives would have been saved. At the crane *g* were found John Elliott, Thos. Stewart. Ralph Watson, Thomas Young, Wm. Hall, Wm. Smith, James Doxford, William Fairley, William Jefferson, John Marshall, Edward Millburn, George Cowey, and James Hughs. These persons had escaped from the places where they were working as far as the crane, where all but Millburn and Hughs had died of exhaustion; Hughs only survived two days; he was severely burnt, and Young, Hall, Smith, and Jefferson were also burnt, but only slightly.

At length, however, the closing of the stopping *k* was accomplished; and as all chance of saving life in the workings to the eastward of the crane *g* was relinquished as hopeless, the stopping *i* was placed in the head-ways course, which forced the current of fresh air up the second west drift, to the crane stenting *i*. This enabled the party to find Thos. Holland, George Shaw, William and Benjamin Robinson, John Naysmith, James Brown, and James Tate; Holland and the Robinsons, brothers, were dead. All the others survived except George Shaw, who lived only two days. None of this party were burnt.

The stopping in the crane stenting *i* was next repaired, which threw the current of air into the face of the drifts. George Thornton and Langly Marley were found in this stenting; Thornton was dead, and Marley was in a state of insensibility—neither was burnt. Marley has continued ever since in a state of insanity. James Pringle was next found in the face of the fore drift at *H*; he was in a state of insensibility. The ventilation was now partially restored round by the face of these drifts, and as far back as the crane *g*. William Richardson, Thomas

Richardson, John Spence, and Richard Storey were found at *i*; Spence and Storey, two boys, were dead, the other two were insensible.

New stoppings were now placed in the headways stentings *m*, *n*, *o*, *p*, *q*, the latter of which was the last that had been blown down in that direction, the remaining stoppings to the face of the headways being only shattered. This threw the current of fresh air into the face of the headways (as marked by the darts on the plan) into the east workings.

On gaining access to the face of the south headways, it was found that no smoke or after-damp had ever penetrated beyond the four-feet down-cast hitch *q*; the atmospherical air having remained there all the time unexpelled, and in a pure state. James Pringle, Thomas Stewart, John Elliott, E. Millburn, and George Thornton, were working in those headways when the explosion took place. They felt the shock and whizzing in the air, but the concussion was not so strong as to put out their candles. They were much alarmed, and ran outwards immediately, but on arriving at the top of the four-feet hitch, which was about fifty yards back from the face, they found the headways there completely filled with smoke and after-damp, which were so hot that they durst not venture into it. They then returned to the face and deliberated, as to whether they should remain, or endeavour to get through the smoke *out-bie*. Pringle got fretful and impatient, and at last determined to run the risk of getting out. He proceeded along the fore headway, on his way out; but on getting on the *out-bie* side of the rise hitch, he found the smoke and after damp so strong and hot, as almost to be insupportable. He however, persevered, and put his linen cap in his mouth, to endeavour in some degree to palliate his sufferings; and after great difficulty and exertion he reached the crane *g*, where, by mistake, he went up the fore west drift, instead of continuing along the headways towards the pit, and was found in the face of the drift *h*, as already described.

After having effected the ventilation of the west drifts and south winning headways, and recovered all the dead and wounded persons out of those workings, they proceeded to restore the ventilation, and to expel the smoke and after-damp from the east workings, so as to enable

them to recover all the dead bodies of the unfortunate people who had perished in that quarter. This was accomplished by four o'clock in the afternoon, but the east drifts remained so charged with inflammable air at that time, as not to be safely accessible; and nothing had then been discovered to explain the cause of the accident. All the people who were found in these workings, had either been killed by the explosion, or died of suffocation before they could make their escape. The places in which they were found are marked on the Plan.

I was from home, and did not arrive at the colliery till near five o'clock in the afternoon; my first object was to examine Johnson, the overman, and others, as to the state of the pit immediately before the accident, and, in short, to investigate every circumstance connected with it, to endeavour, if possible, to ascertain the cause of so unexpected an occurrence. The result was, that I was impressed with the conviction, that it had been occasioned either by the breaking out of a *bag of foulness*, or a *blower*, or both, from the hitch in the face of the back east drift. This appeared the more likely from the quantity of inflammable air with which the two east drifts were charged, while Mr. Forster and his party were occupied in carrying out the dead bodies.

I next proceeded to examine the workings, and travelled through with the current of fresh air, beginning at the sloping stone drift. Although the current of atmospherical air was but faint, not equal to more than one half of its ordinary power, owing to the insufficiency of the temporary stoppings, which had been hastily put up for the purpose of affording the most speedy relief to the sufferers, I did not discover the least appearance of inflammable air in any part of the workings. On arriving near the face of the fore east drift, where it had been charged with inflammable air only three hours before, not the least trace of any remained. I then went into the back east drift, expecting to find out the cause of the accident there, but I found it precisely in the state described by Johnson, when he left it less than half an hour before the accident happened—not the least appearance of inflammable air was discoverable in this place.

The next object of examination was the face of the fore east drift, and

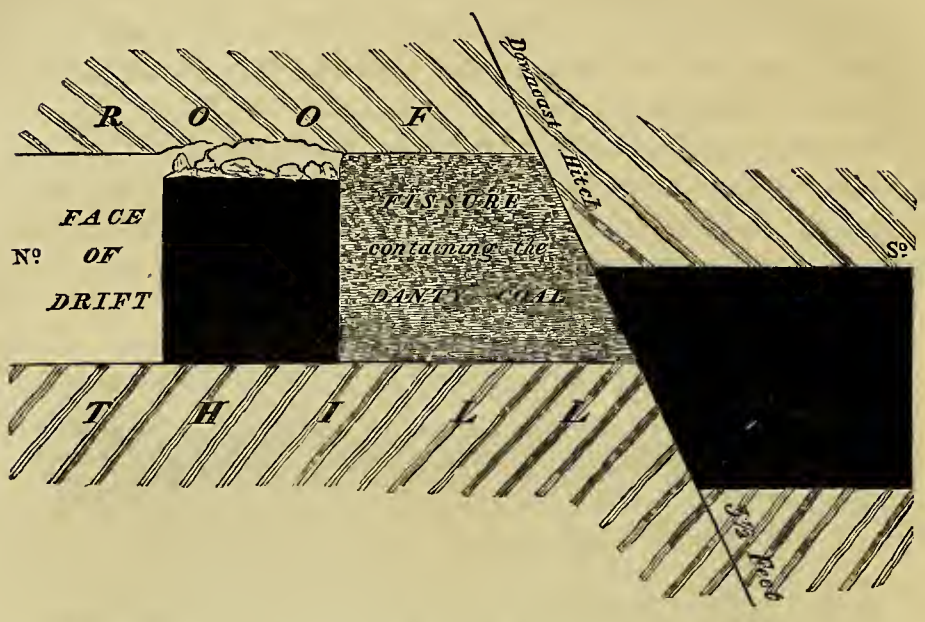
here the cause of accident appeared at once. The face of the drift presented all the appearances of its having holed into an old working, out of which a quantity of compressed air had rushed with vast force, and fired at the first flame it met.

The drift was 9 feet wide, and 5 high, the whole block of Coal, across the face, seemed to have been forced forward with great violence, having a jagged apperture of 9 to 12 inches in width, along the roof, and down its left or north side, as shewn in the diagram No. 1.

No. 1.

On closer examination, the block of Coal in the face of the drift, appeared as if it had been detached by an explosion of gunpowder, leaving a hollow space behind, and a cavity also appeared in the Coal wall, on the left side of the drift. On removing the block of Coal, which did not take place till the 21st of September, it was found to be 4 feet thick from the front to the back, and a space of 7 feet wide behind it, extended to a down-cast hitch of 3½ feet. This space was filled with (*danty*) disintegrated Coal, of a sooty appearance, (a specimen of which I have presented to the Society,) as shewn in Diagram No. 2.

No. 2.

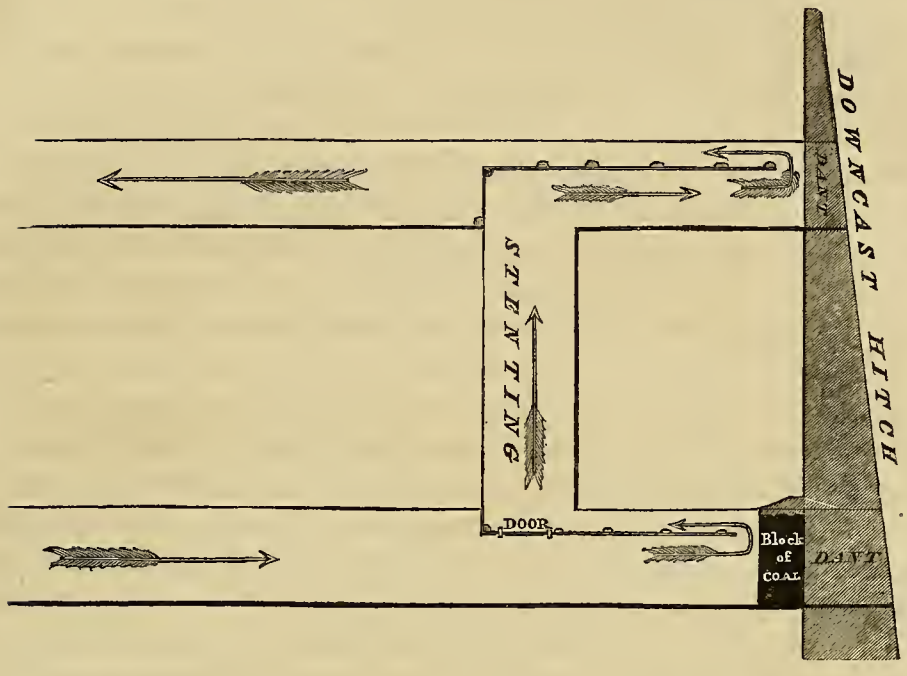


It was evident that a quantity of inflammable air had been contained in this cavity, in a high state of compressure, and that on the Coal being worked away, till it was no longer equal to resist the elastic force of the compressed gas, the gas had escaped, with a sort of explosion, displacing the block of Coal, filled the adjoining workings, and fired at the first lights it met with, after being brought down to the firing point by a due admixture of atmospherical air.

When I first examined this place, no inflammable air was discernible, nor has there ever been the least appearance of any since. From this it would appear, that this was an isolated bag of gas, without communication with any *blower-threads*, whatever, and that it quite exhausted itself by this single eruption.

No fire had been in the face of this drift, but it had evidently sustained a great concussion, either from the sudden eruption of the gas, or from the explosion. And no marks of fire appeared for about 8 yards back from the face, where at the end of the stenting *r*, the gas seems to have become sufficiently mixed with the atmospherical air, to make it explode.

No. 3.



The fire had been very strong in this stenting, and in the back drift as well as in the fore drift, on the *out-bie* side of the stenting. But Joseph Tinkler, who was working in the fore drift, was not at all burnt; he seems to have remained in the face of the drift till after the explosion, and had been suffocated in attempting to escape, as his body was found at the place marked *Q*, on the Plan, Plate XVIII., which is 60 yards back from the face of the drift. The extent of the fire is marked on this Plan by a pink shade, and the extent of the after-damp, by a dark shade.

From this it will be seen, that the fire was not of very great extent, although so fatal in its consequences. It had been what we call a *smart* fire—not a *heavy* one. In this examination, I was accompanied by Messrs. Thomas and John Forster, Coxon, and others.

The diagrams Numbers 1, 2, and 3, shew the shape and situation of the block of Coal, and the cavity.

I have laid upon the table a specimen of the sooty coal taken out of the fatal fissure in the fore drift, and also a specimen taken out of the same fissure in the back drift. The latter, No. 4, it will be perceived, is in a compact and indurated state, while the former, No. 5, is in a state of disintegration.

It seems that the compact state of the sooty Coal, in the fissure between the two drifts and in the back drift, had prevented the eruption of gas from taking place in the back drift. The block of Coal in the face of the fore drift having proved to be the point of least resistance.

By the appearance of the sooty Coal, it would seem to have been exhausted of its bitumen, but on testing it in a tobacco pipe, it seemed to give out quite as much gas as the best part of the seam; the only difference was, that it appeared to give out its gas at a lower temperature. This experiment is not, however, to be depended upon, as it could not be made with sufficient accuracy. No. 1 is the cinder produced from the sooty Coal, and No. 2 is the cinder produced from the best part of the seam. Apparently then, this sooty Coal does not seem to have undergone any material chemical change. The most feasible mode, therefore, of accounting for its presence in this situation is, by supposing the seam to have been crushed by the same convulsion which fractured the strata, and formed the hitch. No. 3, is a specimen of the charred Coal dust, which is deposited in every part of the workings within the range of the fire. This dust flies in all directions in luminous sparks, similar to those discharged from the chimney of an engine, which are frequently propelled by the force of the explosion to a considerable distance beyond where the flame of the ignited gas reaches. They scorch and wound those who may happen to be within their reach, and frequently set fire to any combustible substance they may fall upon —sometimes to the Coal itself.

In the course of the following day, and subsequently, much information connected with this unfortunate affair was collected from individuals who had escaped the catastrophe; and as part of their information may not be altogether uninteresting to the curious, I shall give it without further apology.

George Cowey was working in the face of the fore east drift, on the afternoon preceding the accident, when the Coal in the face of the board suddenly became tender, and flew off in shivers when he struck his pick into it. He said he might have dug six or eight and thirty corves, with more ease than he could have dug eighteen in an ordinary way before. This was indicative of some unusual change in the seam, and it is to be regretted that Cowey did not mention the circumstance to any one till after the accident, for, had he reported the circumstance to the overman, the further prosecution of the drift would have had his special attention, and in all probability, the accident might have been avoided.

The crane-man, William Brown, was in the act of chalking the account of the work on his board when the explosion happened. He felt a sudden gust of cold air from the east drifts, and was the next instant enveloped in flame—this was momentary, and was succeeded by a scalding hot atmosphere, which continued as long as he was sensible. He made an effort to escape, and was taken up at the point *D* as already described.

Joseph Pringle's escape from the south headways has already been noticed. His companions, Stewart, Milburn, Elliott, and Thornton, remained in the headways beyond the hitch for some time, where the air continued in a good state. They put on their clothes and came to the hitch, but on going beyond it, they fell in with the cloud of hot smoke and after-damp. They then held a consultation as to what was best to be done, when Elliott urged the propriety of remaining in the fresh air on the *in-bie* side of the hitch, and waiting the event of measures being taken for their relief. Had Elliott's advice been followed, the lives of his comrades, as well as his own, would have been saved; but they unfortunately differed with him in opinion, and left him to endeavour to save themselves by struggling through the vitiated atmosphere to the pit. The only survivors were James Pringle and Edward Milburn, the latter of whom gives the account. It seems that Elliott must soon have followed his comrades, as his body was found at the crane *g*, lying beside Milburn.

The people working in the second west district, consisting of about fifteen individuals, on finding the shock of the explosion, collected themselves together in the face of the drifts, and proceeded down the fore drift to the crane *i*, but meeting with the smoke and after-damp there, they durst not venture through, and returned by the face of the drifts, and down the back drift to the crane stenting *i*. Meeting with the smoke and after-damp here again, they felt much embarrassed and alarmed, and held a consultation as to what they should do to save their lives. It was at length resolved to endeavour to force their way down the back drift and through the openings *s* and *t* into the headways at the *in-bie* end of the horizontal stone drift, and thence *out-bie* along the railway. Their strength however failed them, and they fell at the point *F*, where they were taken up as already noticed; they all survived except Holland and Shaw—who were both stout robust men.

Robert Fairley, the master wasteman,* with Coxon's son, a boy of fourteen years of age, were in the inclined stone drift when the explosion happened. They were thrown down with great violence by a sudden gust of wind from the interior of the mine; part of Fairley's clothes were torn off, and he, as well as the boy, were thrown about and contused. This gust of wind continued for a few seconds, when it was succeeded by a sudden and strong *in-draught* of air. This always takes place on such occasions—the cause is obvious.

Although the concussion was distinctly felt in the most distant parts of the workings, the injury done to the mine was by no means so serious as might have been expected—only two horses were killed.

It will be observed that the *immediate* cause of this explosion was the ignition of the gas at the flame of some of the candles used by the workmen, as candles were generally used in this part of the colliery.

Here the question, why were candles used at all, and why was not the safety lamp exclusively adopted? suggests itself. The reason why

* Wastemen, a set of men who are constantly employed in travelling the air courses, keeping them in repair, and attending to the ventilation. Their duty is an arduous and important one, they are always promoted from the body of colliers for their superior intelligence and good character.

the safety lamp was not generally used, nor can be generally used in future, is, that the use of gunpowder in the working of the coal is quite indispensable, and, as the inflammable air ignites at the explosion of gunpowder, our main dependence must, in all such cases, rest chiefly upon the efficiency of the ventilation. Without the use of this powerful auxiliary, it is not practicable to work the coals out of this part of the mine in a marketable state, nor at a price that would pay for the working. Many collieries are similarly circumstanced, and a certain degree of risk must, therefore, be unavoidably incurred, or they must cease to be worked.

By proper precautions in firing the *shots*,* and the occasional use of the safety lamp, the degree of risk may be greatly lessened. As it is only in such cases as this, now under our consideration, that any material risk of explosion can arise, and even this risk may be obviated by due vigilance and attention on the part of the colliers and of those to whose care they are committed.

In viewing the back east drift this morning (October 18), I observed the Coal in the face to have assumed the same sort of appearance as is described by Cowey, to have occured in the fore drift a few hours before the accident happened, on the 3d of August, that is to say, the Coal has become shivery and tender, and on striking it with the pick it sounds hollow.

I have directed a bore hole to be made, and continued six yards in advance of the face, so that if a bag of foulness should lie in front of the line of the drift, it will be tapped by the bore-hole, and the gas let off without incurring any risk; and I feel persuaded, that if Cowey had given due notice of the change he observed, so as to have allowed of the precaution of an exploratory boring being made in front, the accident might have been prevented.

It is impossible to say too much in praise of the colliers belonging to the colliery, for their prompt exertions in endeavouring to save the lives of their unfortunate brethren on this melancholy occasion, as well as to the viewers, overmen, and workmen belonging to the neighbour-

* Shots, blasting the Coal.

ing collieries, for the alacrity with which they volunteered their services. The kind feeling and sympathy of the colliers through the whole district, for the distress occasioned by this catastrophe, have been evinced in the strongest manner by the liberal subscriptions they have made for the relief of the widows and orphans of the sufferers. May we not hope that this laudable feeling may be directed to the formation of a permanent fund for the relief of sufferers, arising from the various casualties incidental to coal-mining, in which, it is scarcely to be doubted, that the coal-owners, as well as the coal and landed proprietors of the country immediately connected with the coal-trade of the north, would cheerfully join.

A handsome subscription has also been raised by the activity of Mr. George Major and other humane individuals, which has greatly relieved the distress of the widows, children, and other dependents on the labour of the individuals who suffered on this melancholy occasion.

POSTSCRIPT.

It may not probably be deemed unimportant to remark, that in continuing the east drifts beyond the hitch where the fatal eruption took place, certain phenomena of rather unusual occurrence in coal-mining appeared.

As the workmen proceeded, powerful eructations as loud as the report of a musket frequently took place when the coal was struck by the pick, and large splinters were thrown off by their force to the great annoyance and alarm of the workmen. The presence of inflammable air was never discoverable by the safety lamps when those eructations took place, but from the strong pungent and sulphureous smell which always accompanied them, I had reason to think that they were accompanied by a discharge of sulphuretted hydrogen.

Eructations from the Coal are by no means uncommon when struck by the pick, but the eructations above described exceeded beyond comparison, in point of force and loudness, any thing of the kind that

either myself or any person else who heard them had ever experienced. And it is by no means improbable that the forcing out of the block of coal in the face of the fore drift, when the accident happened, may be attributed to an eruption of a similar nature, but of much greater magnitude.

In driving the second west drifts *F*, *G*, *H*, *I*, Plate XVIII., a powerful eruption of inflammable air occurred in December, and a similar one in January. Both these eruptions forced off a mass of Coal from the face of the fore drift, and discharged a large *bag of foulness* precisely similar, but of less magnitude, to that which occasioned the accident on the 3d of August. Both these eruptions occurred at small *hitches* in the seam, accompanied by *linings* of *danty* or disintegrated Coal, from which it is to be presumed that the law of this part of the mine is to discharge its gas from those *reservoirs* or fissures of disintegrated Coal; as very little gas is discharged from the pores of the good Coal. It would seem as if those fissures of disintegrated Coal formed runners, channels, or outlets for the gas which has been evolved from the adjoining mass of Coal.

The east drifts have only been extended a few yards beyond the hitch where the accident happened, as it has not yet been necessary to pursue them further.

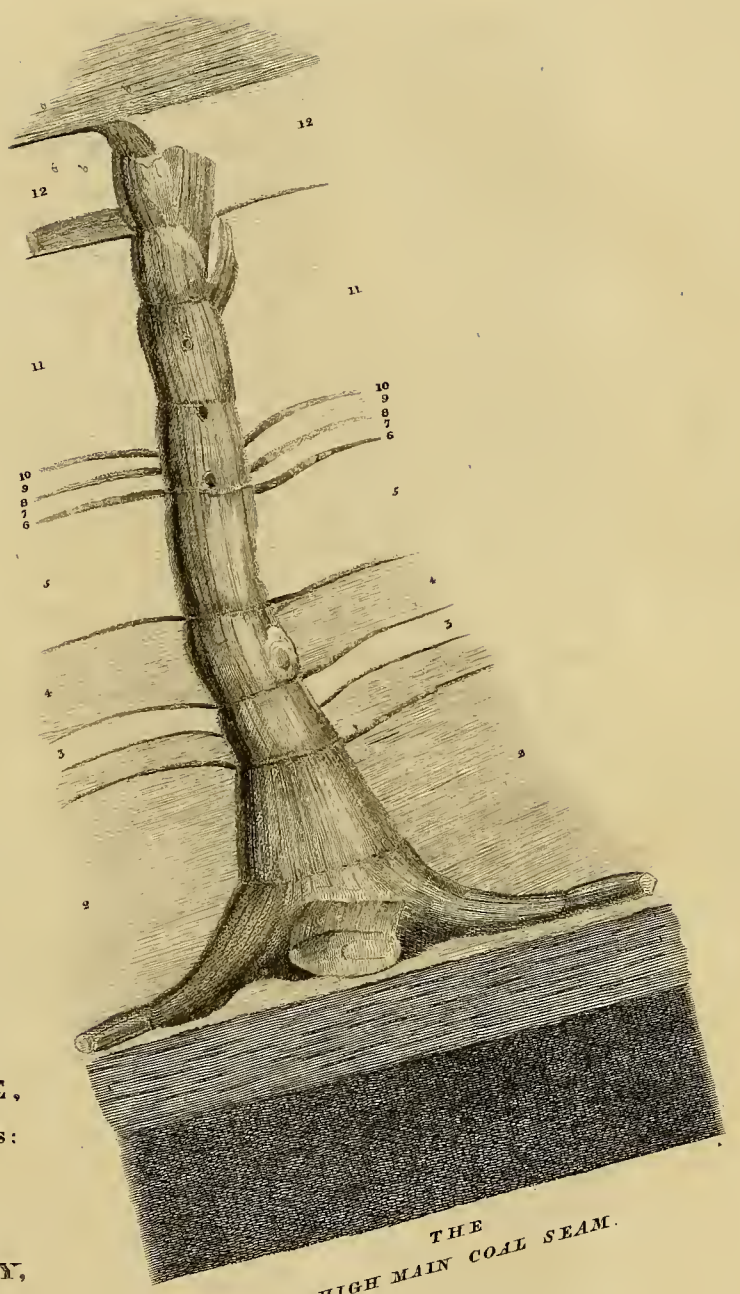
February 1, 1831.

No. XXI.—*Account of some Fossil Stems of Trees, found penetrating through the Strata above the High Main Coal, at Killingworth Colliery, at a depth of* 48 *fathoms. By* Mr. Nicholas Wood.

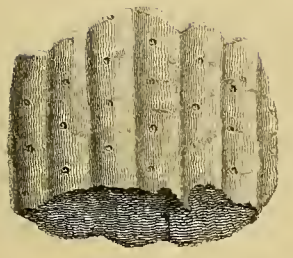
Read November 15, 1830.

The occurrence of Fossil Trees in the Sandstones of the Coal formations of different countries has been noticed by many observers. Messrs. Conybeare and Phillips, in their *Introductory Notice of the Coal Formations of England,* give numerous examples, where different kinds of fossil stems or trunks of trees have been found, principally derived from the labours of Count Sternberg and Mr. Steinhauer. Monsieur Brongniart, in the *Annales des Mines* for 1821, describes several existing on the Sandstone above the uppermost Coal near St. Etiène. Dr. Brewster also gives an account of some existing in Scotland, and Mr. Trevelyan, of the existence of some in the cliffs of the carboniferous strata on the east coast of Northumberland, and more recently we have the example of one found embedded in the Sandstone Quarry of Wide-open, near this town. Several of these are of foreign localities, and most of them from quarries near the surface of the earth, and almost all seem more as embedded fossil remains, than as prototypes of vegetables which have lived on the spot where their remains are found: at least, almost all, if not every one of the instances leave this latter fact undecided. Of the numerous specimens cited by M. Brongniart, only one kind "appeared to spread out in the manner of a root, but without any ramification." A description is given in Thomson's *Annals of Philosophy,* November, 1820, of the trunk of a tree found in the Sandstones of the Coal formation of Glasgow, the roots of which, especially four of large size, dipped under the ground like ordinary trees. The Rev. P. Brewster also figures a stem with branching roots, found at

N° 1



N° 2



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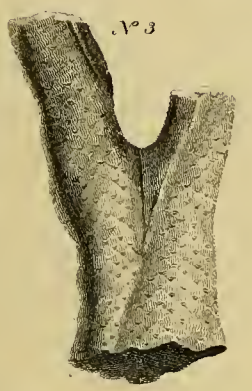
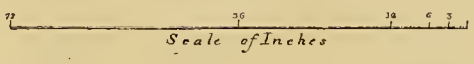


SKETCH
of the
FOSSIL STEM of a TREE,
found at a Depth of 48 Fathoms:
ABOVE THE COAL,
in the Workings of
KILLINGWORTH COLLIERY,
SEPT 1830.

Lambert Sc



Nites-hill, but the whole of the carbonaceous bark being stripped off, its species could not be discovered.—*Edinb. Phil. Trans.* vol. ix. None of the examples cited by Mr. Trevelyan, and only one instance of foreign locality noticed by M. De Charpentier, at Waldenbourg, in Silesia, exhibit indications of these trees having vegetated on the spot where they were found, and even this instance of M. de Charpentier was not to him sufficiently conclusive of the fact of their primitive situation. Under these circumstances, I trust, therefore, that I need make no apology in offering to the notice of the Society the following Account of some Fossil Stems of Trees, found in the workings of the Killingworth colliery; the roots of which are well identified, not only with the fossil itself, but also with the inclosing strata; and also in presenting for their acceptance one of the most perfect specimens I have been able to obtain, with some specimens of the numerous impressions of vegetables accompanying the strata in which these fossil stems are found.

It is necessary perhaps to give a short sketch of the situation of the strata in which these remains were found, in order to shew their connection with some of the predominant strata of the district, and more particularly with the bed of coal of which they seem to be the accompaniment.

The south boundary of the Killingworth colliery is, what is called the great or 90-fathom Dyke, which runs nearly east and west; the throw of this Dyke, which is down to the north, is considerably more than 90 fathoms, as noticed by Mr. Hutton, in the first volume of your *Transactions*.* From this Dyke to the north, the beds rise very rapidly for a few hundred yards, the inclination then gradually moderates, until at the distance of about a mile, when the line of water-level becomes due north, and the full dip west, or the very contrary direction to that near the Dyke. This position of the strata is quite irregular, the general line of direction of the strata of the district being NE. and SW., the rise NW., and is no doubt occasioned by the influence of the great and other slip Dykes which traverse this colliery. To a certain extent from the great Dyke as before noticed, the Coal rises rapidly until we get beyond the sphere of its influence, and come within that of a cross

* Page 73.

Dyke which ranges north and south, when the dip changes and becomes due west. Near the great Dyke, the immediate cover of the high Main Coal is Sandstone, or "Post," compact, varying in thickness from 12 to 15 fathoms, and called the "Main Post." This stratum of Sandstone gradually diminishes in thickness from the great Dyke to the north, until it is entirely lost. This is not however to be taken generally, but as being the case in this particular district, for in many places the Sandstone, or Post, is the cover of the Coal for a very considerable distance from the Dyke.

It might be supposed that where the Sandstone thins, and eventually runs out, the superincumbent bed will then become the cover or roof of the Coal, but it is necessary to remark that this is not the case. At a considerable distance before the Post runs out, a thin bed of Argillo-bituminous Shale interposes itself between the Coal and the Sandstone; at first extremely irregular in its occurrence, but gradually becoming more continuous towards the north, until it ultimately becomes the exclusive roof of the Coal. While this bed of Shale is from 1 to 2 feet in thickness, it is of a uniform Argillo-bituminous nature, but when its thickness increases, and the Post is split into thin layers, about 12 or 13 inches of the lower part of this bed still retain the same character of "Blue Stone" (No. 1), but the upper part becomes distinctly separated by what is called by the miners "the black parting," and becomes of a more silicious nature, with innumerable minute specks of Mica, or what is called "Blue Metal Stone" (No. 2), which seems to pass insensibly into, first micaceous, and then compact "Post," a Sandstone, being probably a continuation of the Main Post. It was in these strata the immediate cover of the Coal, and at a depth of about 48 fathoms from the surface, that the fossil stems were found; and the following is a section from the Coal upwards of the beds inclosing these remains, specimens of which, numbered as per margin are presented.

No.		Ft.	In.
	Coal High Main Seam	6	0
1.	Blue Metal, or Argillo-bituminous Shale	2	3
2.	Blue Metal Stone,	1	1
3.	Parting Silicious	0	0
	Carried forward	9	4

No.		Ft.	In.
	Brought forward	9	4
3.	Same bed as previous one	0	7
3.	Post Girdle or thin layer of Micaceous Sandstone	0	3
4.	Blue Metal Stone, same as No. 2.	0	7
5.	White Post, or compact Sandstone	1	2
6.	Black Metal, or Bituminous Shale	0	$1\frac{1}{2}$
7.	White Post	0	3
8.	Blue Metal Parting	0	2
9.	White Post Girdle	0	4
10.	Black Metal	0	2
11.	White Post	2	3
12.	Leavy Post, or Micaceous Sandstone	1	2
		16	$4\frac{1}{2}$

In working away the pillars of Coal in this district of the colliery, viz. about half a mile south from the Burraton Engine Pit, and about two miles due north from the village of Long Benton, the superincumbent strata falling down, exposed the fossil stem presented, in the situation, as shewn by the accompanying sketch; and on a further, and more minute examination of the different parts of the workings, a great many more were discovered that had before escaped notice; and as the real position of these stems seemed an object of great interest to Natural History, the strata were worked away until the top of the stem was reached. The specimen presented was much broken by the crushed strata occasioned by the working of the pillars, but on tracing some more of these stems where the beds were not so broken, I found this was the most perfect we could obtain. The bed, No. 1, of the Section, being compact, contains very few vegetable impressions, though it is by no means destitute of them, but between it and No. 2 is a smooth and perfect parting noticed before, as called the "black parting," the face of which is literally covered with vegetable impressions, a few of which I take the liberty of presenting to the Society. For some distance upwards from this parting, a considerable quantity of these impressions exist, but they become more scarce towards the middle and top; and in the Post girdle few, if any, except the larger stems similar to that presented, are found.

The accompanying figures, (Plate XIX.,) will shew the position of the

fossil, with respect to the inclosing strata. It will be seen from these that it consists of an upright stem, not quite vertical, with roots proceeding from the bottom of it, and penetrating the lower part of the bed, No. 2. The specimen will shew that the interior is filled with white Sandstone; or that, in point of fact, it consists of a cylinder of white Sandstone in the form of a stem of a tree, and that, the only remains of its vegetable nature, is a coat of carbonaceous or coaly matter surrounding the sandstone. In the removal of such weighty specimens, it is feared a considerable part of this has been effaced, yet it is trusted sufficient remains to shew the nature of the vegetable. On an examination of the Sandstone of the fossil, and the specimens of the strata in which it was imbedded, it will be seen that it is the same kind of Sandstone as that surrounding it near the top, or Nos. 9, 11, and 12, and the roots though penetrating for a considerable distance into the stratum, No. 2, of a quite different kind of stone, are filled with the same Sandstone. The stem, at first sight, has the appearance of being fluted, with joints at variable distances from each other, but these appear to have been almost, if not entirely, owing to the effect of the compression of the enveloping strata. The lower part or base of the tree was about 2 feet in diameter, flattening out considerably at the bottom; this part was so much broken that it could not be procured, but the bed of it with the roots proceeding from it was most clearly seen *in situ*. The roots could be traced for about 4 feet from the stem, penetrating the Shale, but the compact nature of the Shale prevented us from obtaining specimens, when the thickness of the roots diminished; but they were seen running into the Shale composed of the same kind of sandstone, though a little more indurated, until they were half an inch thick; a drawing of one of these roots, Figure No. 2, with a specimen, showing a ramification, accompanies this. The roots were not numerous, but run into the Shale quite parallel with the inclination of the beds, and spread out from all the different sides of the fossil.

The dip of the strata here is west, about 12½° and the position of the stem is nearly perpendicular to the inclination of the beds, passing through all those above No. 1 in the section. The size at the junction

of the roots is about two feet, but as seen in the drawing, it diminishes in size upwards and about five feet from the base it is only about 12 inches; the size does not diminish gradually, but at different places resembling joints. At this height it is nearly round, but above this the rotundity is destroyed, apparently from the compression of the surrounding strata. This irregular and broken section continues upwards for about four feet, when a remarkable change takes place. Up this height, nearly ten feet, the position is nearly vertical, or at right angles to the line of stratification, but here it takes a sudden bend towards the south-west, becomes flattened, and continues nearly horizontal between the beds of the strata, or into the top of the bed of Micaceous Sandstone, No. 12, and between that and a bed of metal stone of a very micaceous nature, No. 13. *See* Plate XIX., Figure 1.

The thickness of the specimen diminishes rapidly when it approaches a horizontal position, and when it becomes quite so, is only about half an inch thick; the Figure No. 3, will shew the face of the flattened part from the dotted line on the stem *a a* to *b b*, the width of which is about 19 inches. The flutings on the upright part seem very narrow, and not well defined, but when flattened, they were very distinct, and were from $2\frac{1}{2}$ to 3 inches in breadth, as shewn in the accompanying specimen and Figure No. 3. How far the impression of the top extended along the bed of Sandstone, we could not determine, not being able to follow it more than 2 or 3 feet; but it did not for that distance diminish in width, and apparently continued much further.

Near the top, a branch apparently proceeded from the dislocated part of the stem, as shewn in Figure No. 1, but it was so much broken in this part as to leave the existence of the junction quite undeterminable; the Figure shews the appearance *in situ*, but whether it was a branch proceeding from this fossil, could not be satisfactorily ascertained.

Within an area of 100 square yards, a very great many of the Fossil Stems exist, many of them of much larger dimensions than the specimen presented, and several smaller; in some instances they are nearly close together, the roots of the one exhibited extending beyond an adjoining stem. In some of them the thickness of the carbonaceous coat-

ing is much greater, but they seem all of the same character, proceeding from the same bed of Shale, and the position nearly upright, or at right angles to the line of stratification. All these were filled with Sandstone, but some of them with a rather different kind than the one presented; but on following them a little way upwards, it was found they were all filled with the same kind of Sandstone as that in which they were embedded near the top.

It is, perhaps, difficult to ascertain precisely to what genera or family these fossil remains belong—the following conclusions seem to result from these phenomena :—

That on a comparison of the Fossil Stems and accompanying vegetable impressions with living vegetables, they appear to be allied to those existing in tropical regions of the south.

That they have been plants of a reedy (*fistulaire*) nature, and consequently inhabitants of a marshy soil, and that their hollow stems have been filled by the deposition of the materials forming the rock in which they are enveloped. This fact is proved by the sandstone composing the filling matter containing very frequently impressions of leaves, or the smaller vegetable remains, which is incompatible with the supposition of a substitution of silicious matter on the decay of a solid woody substance, effected by infiltration. Besides, the termination of the top of this Fossil Stem most distinctly proves its nature; for it is impossible to conceive that any other vegetable than that of a reedy nature could be compressed so flat, and yet exhibit so perfect and unbroken an impression of the original bark, or exterior surface. The plant most nearly corresponding with all the appearances is of the class *Sigillaria* of Brongniart, or *Syringodendron* of Sternberg.

That these stems or vegetables have been inhabitants of, and have lived in the place in which they are found.

This is perhaps a conclusion to which we should approach with the greatest caution, as furnishing evidence of a fact of the greatest importance to geology. The only supposition in contradiction to this fact is, that they may have been drifted there, enveloped in the strata in which they are found. When we consider, however, the manner in which the roots penetrate strata of a quite different nature from that in which the

stem of the fossil is imbedded; the very perfect, unbroken, uninterrupted, and minute impressions of the vegetable nature of the original which they retain, no other conclusion can be drawn, than that their transformation from living vegetables to fossil organic remains has been the result of the deposition of the silicious matter into the hollow trunks of these plants; and that this must have taken place while the vegetation was in its perfect state of organization, and that it must have been done in the most quiet manner, so as to leave impressions of the most minute texture of the external coat of the vegetables. If, therefore, we suppose that the filling up of the stem of this plant has been effected by the quiet deposition of the silicious matter within it, deposited in the way of sediment, while the vegetation was perfect; we cannot suppose that it could be transported from one place to another while the consolidation of the whole was imperfect; for no material, of either a fluid or semi-fluid nature, could convey, suspended within it, any distance, so many stems of so frail a nature, and yet preserve their upright position and original form so very perfect. But the fact of the roots penetrating, without injury to their natural form, a substance of so different a nature from that of the mineral filling the stem, and from that of the strata in which it is inclosed—and the fact also of the bed containing the roots, and the superior one embracing the stem being of so different a nature, and separated from each other by a smooth, level, and distinct parting—preclude the idea that the whole mass has been transported from any distance to the place where they were found, either while in a fluid or semi-fluid state: And as we cannot suppose they could be so transported when the consolidation was perfect, the legitimate conclusion is, that these Fossil Stems are the representatives of vegetables that have lived on the spot on which they were found. It is not necessary, perhaps, in a paper of this kind, to pursue the theoretical conclusions resulting from the facts developed by the discovery of these fossil remains any further; but we may be inclined to indulge a supposition, from a minute examination of all the phenomena attending the structure, texture, and position of these remains, and their connection with the strata enveloping them, that they are the prototypes of living vege-

tables, which have been rooted in, and grown in the sedimentary deposit of which the bed, No. 2. is the representative. If we suppose this, we account for the innumerable impressions of the various plants covering the face of that bed. The Coal would then be the substratum on which the layer of mud or soil rested, in the middle of which these roots are found, and from which these plants probably vegetated. Supposing this to have been the case, and these plants to have been in their natural state of vegetation, we can only account for the quiet manner in which they have been filled up, and imbedded in the sandstone, by supposing that, by some cause or other, they must have been immersed in water, which has subsequently been the medium of the deposition of the materials forming the bed of sandstone, and which, at the same time, filled the interior of the stem of the plants. The bend in the top of the stem has, we may suppose, been caused by its reaching above the surface of this deposit, and thus, being unsupported, has fallen down and become covered by a deposit of a different nature.

Without indulging in any theory as to the origin of the Coal itself, if the foregoing premises be made out, we come to the conclusion that the Coal in this particular district was at one time covered by a layer of matter, in which plants of a nature similar to those existing only in tropical climes vegetated; thus proving an epoch when this was the surface of the earth, and which must have remained so a length of time necessary for the vegetation of these plants, previous to their being enveloped by the sediment forming the beds in which they are found.

It may not, perhaps, be irrelevant to state, that, throughout the whole of this district, a bed of black Bituminous Shale, of several feet in thickness, occurs a few feet above the "main Post," which, in many places, contains layers of bivalve shells, resembling the fresh-water muscle, shewn in a specimen presented. This bed occurs about 8 or 10 feet above the strata at the top of these fossils.

I shall afterwards, when the convenience of the Society's Rooms will admit of their reception, have the honour of presenting specimens of all the different strata, from the surface to the seam of Coal above which these fossil remains are found.

SKETCH
— of the —
NEWCASTLE COAL FIELD
Divided into Districts.

Collard Sculp.

No. XXII.—*Synopsis of the several Seams of Coal in the Newcastle District.*

By John Buddle, Esq., *Colliery Viewer.*

Read December 20, 1830.

INTRODUCTION TO SYNOPTICAL TABLE, &c.

I have been induced to present to the Society the accompanying Synoptical Table and Account of the several Seams of Coal in what may be considered the *working* part of the Newcastle Coal Field, together with the Sections which accompany this Memoir, in the hope of being able to bring into an intelligible point of view, as far as circumstances will permit, the whole of the workable seams which have yet been discovered within the limits of the Field, so far as they can be identified.

The difficulty and embarrassment, which the geologist or scientific inquirer experiences in investigating our Coal district, from the discrepance and apparent confusion in the arrangement and relative position of the several seams of Coal, owing to the same seams being called by different names, in different parts of the district, is well known. I therefore present this paper to the Society, in the hope of being able, in a considerable degree, to remove such difficulty, and to render the knowledge of our Coal Field more easy of attainment.

I also hope that it may not be unworthy of the attention of the Land and Coal proprietors, as well as the Coal owners of the district, and that it may likewise be useful to the young men of the colliery-viewing profession.

I have been the more anxious to furnish this paper to the Society with as little delay as circumstances would allow, as I am not without hopes that it may, in some degree, be useful, as far as it goes, to those

members of the Society who have volunteered to lend their assistance in the construction of a Geological Map of the northern part of the kingdom, comprising the counties of Northumberland, Durham, and Cumberland, and that it may tend to direct the attention of all to this important object, who may feel interested in its accomplishment, and thus to induce them to lend their aid in promoting its completion, by pecuniary subscriptions and donations, or by communicating information.

I have endeavoured to illustrate the irregularity and changes in the different seams of Coal, and the leading features of the strata, together with several Slip Dykes and dislocations, as they have been proved in different parts of the district by a set of sections which accompany this paper.

The Table shews the variation in the distances between the several seams in different places; also, where two or more of them become united or separate—likewise, where some of them are wanting, or have not been deposited. And I have thought it best to divide the Field into four principal districts, and five divisions, as below, and which will be better understood by referring to the accompanying Map, Plate XX., and more detailed description of the several seams included in the Table.

RIVER TYNE.

East of the Meridian of Newcastle..... .....Newcastle Division, coloured pink.

West of the Meridian of Newcastle. .... { Tanfield Division, coloured blue. / Ryton Division, coloured buff.

RIVER WEAR.

East of the Meridian of Chester-le-Street.....Houghton-le-Spring Divison, coloured green.

West of the Meridian of Chester-le-Street....Pelton and Beamish Division, coloured yellow.

The depths from the surface, and the distances between the several seams as stated in the Table, are not generally taken from the actual admeasurement of any particular colliery or pit, but are an approximation of the medium depths and distances in the centrical part of each district or division. The general Sections of the Strata illustrate, as far as they go, the distances, inclination, bendings, and throws of the several seams; together with their relative depths and heights, below and above the sea level high water mark.

By referring to the descriptive notes and sections which accompany this Paper, it will be seen that the several seams vary, not only in thickness and character in different parts, but also in quantity; and it is perhaps not unimportant to remark, that almost all of the seams of Coal become more or less deteriorated in quality, whenever Sandstone happens to form their *immediate* roof, generally a thin stratum of Clay slate interposes between a Sandstone roof and the Coal, and the deterioration of the Coal is in some degree proportionable to the thickness of the interposing clay-slate, that is to say, the thicker it is, the less is the degree of deterioration, and *vice versa;* but the degree of deterioration is always greatest when the Sandstone forms the immediate roof of the seam, and is in actual contact with the Coal.

Besides being deteriorated by a Sandstone roof, the Coal is almost invariably more or less intermixed with Iron Pyrites under such a roof. Indeed I consider Iron Pyrites a regular concomitant of a Sandstone roof. I merely mention this incidentally, as the roof stones of our seams of Coal will probably become the subject of a future paper.

The country embraced in the table, extends over only what I consider to be, strictly speaking, the Newcastle Coal Field. That is to say, it only includes those collieries which now ship, or ever have shipped their coals on the rivers Tyne and Wear, and at Hartley and Blyth. I look forward to the labours of those members of the Society to whom may be confided the construction of the Geological Map, for a more detailed and extended developement of the subject to which this Memoir may merely be considered the precursor.

The Sections of the Strata which accompany this Memoir, and for the construction of which I am indebted to the talent and industry of Mr. Williamson Peile, are intended to illustrate the Synoptical Table. They may also be considered as a specimen of the sections which will be required to illustrate the proposed Geological Map of the district. I shall afterwards give a set of sections to a scale from actual admeasurement of the several seams as they are found in the districts contained in the table.

NOTES REFERRING TO THE SYNOPTICAL TABLE AND MAP.

The Newcastle Coal Field is divided into two large districts, called the Tyne, and Wear Water; the former comprising all the collieries which ship their coals on the Tyne, the latter comprising all those collieries which ship their coals on the Wear. To facilitate the description of this Coal Field, I have sub-divided the Tyne and Wear districts, each into two parts, as follows, viz. :—

THE TYNE.

The sub-division east of the meridian of Newcastle, coloured *pink* on the Map, Plate XX., extends from the river Blyth to the south side of the Tyne, as far as the seams of Coal have yet been explored in that direction. The sub-division west of the meridian of Newcastle, coloured *buff* and *blue* on the Map, extends from the line of separation between the collieries, on the two rivers, to the south, to the crop of the several seams to the west and north. I have found it necessary to separate this subdivision into two parts, viz. the Tanfield and Ryton districts, as will appear afterwards.

THE WEAR.

The sub-division east of the meridian of Chester-le Street, coloured *green* on the Map, and which I call the Houghton-le-Spring sub-division, extends from the line of separation, between the rivers on the north, as far to the south of the Wear as the Coal has yet been explored in that direction—say to Shadforth. The sub-division west of the meridian of Chester-le-Street, coloured *yellow*, extends from the Tyne district on the north, to the Auckland country to the south, and to the crop of the seams to the west.

REFERENCE TO THE SYNOPTICAL TABLE.

RIVER TYNE SUBDIVISION, EAST OF THE MERIDIAN OF NEWCASTLE.

A. *The Monkton and Hebburn Fell Seam* is the first of the series.

SYNOPSIS OF THE SEVERAL SEAMS OF COAL IN THE NEWCASTLE DISTRICT.

RIVER TYNE.

EAST OF THE MERIDIAN OF NEWCASTLE.

	NEWCASTLE DIVISION.	DISTANCE BETWEEN SEAMS.	DEPTH FROM SURFACE.	THICKNESS OF SEAMS.
	NAMES OF SEAMS.	FMS.	FMS.	FT. IN.
A.	Monkton and Hebburn Fell Seam	20	20	2 10
B	Three-quarter Coal	82	102	1 2
C.	High Main Coal	30	132	6 0
D.	Metal Coal Seam	7	139	3 0
E.	Stone Coal Seam	7	146	0 8
F.	Yard Coal Seam	10	156	3 0
G.	Bensham Seam	12	168	4 8
H.	Six-quarter Coal	15	183	2 6
I.	Five-quarter Coal	4	187	2 8
K.	Low Main Coal	6	193	6 0
L.	Crow Coal	10	203	0 10
M.	Ryton Five-quarter Coal	9½	212½	0 5
N.	Ryton Ruler Coal	4	216½	5 0
O.	Beaumont Seam	18½	235	3 5
P.	Not yet found.			
Q.	Not yet found.			
R.	Not yet found.			
S.	Not yet found.			

WEST OF THE MERIDIAN OF NEWCASTLE.

	TANFIELD DIVISION.	DISTANCE BETWEEN SEAMS.	DEPTH FROM SURFACE.	THICKNESS OF SEAMS.
	NAMES OF SEAMS.	FMS.	FMS.	FT. IN.
A.	Cropped out.			
B	Cropped out.			
C.	Shield Row Seam	36	36	4 10
D.	Five-quarter Seam	12	48	4 2
E.				
F.	Brass Thill Seam	7	55	4 10
G.				
H.	Hutton Seam	28	83	6 6
I.				
K.	Low Main Coal	7	90	3 0
L.	Crow Coal	14	104	1 5
M.	Ryton Five-quarter Coal	7½	111½	0 6
N.	Ruler Coal	4	115½	1 11
O.	Harvey's Low Main or Busty Bank Seam	14½	130	6 0
P.	Not yet found.			
Q.	Not yet found.			
R.	Not yet found.			
S.	Not yet found.			

	RYTON AND WALBOTTLE DIVISION.	DISTANCE BETWEEN SEAMS.	DEPTH FROM SURFACE.	THICKNESS OF SEAMS.
	NAMES OF SEAMS.	FMS.	FMS.	FT. IN.
A.	Cropped out.			
B	Cropped out.			
C.	Cropped out.			
D.	Cropped out.			
E.	Cropped out.			
F.	Cropped out.			
G.	Cropped out.			
H.	Cropped out.			
I.	Cropped out.			
K.	Grand Lease Main Coal	11	11	6 6
L.	Crow Coal	10½	21½	2 3
M.	Five-quarter Coal	3½	25	3 8
N.	Ruler Coal	5½	30½	1 8
O.	Townley Main, Upper Main, Barlow Field, or Engine Seam	16½	47	3 10
P.	Stone Coal, Five-quarter Seam, or Main Coal Seam	15	62	2 9
Q.	Under Five-quarter Seam or Six-quarter Seam	3½	65½	3 4
R.	Three-quarter Seam or Yard Seam	4	69½	2 6
S.	Brockwell, Horsley Wood, or Splint Coal Seam	9	78½	3 2

RIVER WEAR.

EAST OF THE MERIDIAN OF CHESTER-LE-STREET.

	HOUGHTON-LE-SPRING DIVISION.	DISTANCE BETWEEN SEAMS.	DEPTH FROM SURFACE.	THICKNESS OF SEAMS.
	NAMES OF SEAMS.	FMS.	FMS.	FT. IN.
A.	Not known.			
B	Not known.			
C.	Three-quarter Coal	68	68	1 8
D.	Five-quarter Seam	14	82	3 6
E.				
F.	Upper or High Main Coal	11½	93½	6 0
G.	Maudlin Coal Seam	11½	105	5 9
H.	Not yet found			
I.	Low Main Coal	10½	115½	2 0
K.	Hutton Seam	14	129½	3 9
L.	Not yet found.			
M.	Not yet found.			
N.	Not yet found.			
O.	Beaumont Seam	22½	152	2 0
P.	Not yet found.			
Q.	Not yet found.			
R.	Not yet found.			
S.	Not yet found.			

WEST OF THE MERIDIAN OF CHESTER-LE-STREET.

	PELTON AND BEAMISH DIVISION.	DISTANCE BETWEEN SEAMS.	DEPTH FROM SURFACE.	THICKNESS OF SEAMS.
	NAMES OF SEAMS.	FMS.	FMS.	FT. IN.
A.	Cropped out.			
B	Cropped out.			
C.	Shield Row Seam	19	19	4 0
D.	Five-quarter Seam	12	27	6 6
E.				
F.	Main Coal or Brass Thill	10	37	4 7
G.	Maudlin Coal Seam	22	59	4 3
H.	Not yet found.			
I.	Low Main Coal	5	64	4 0
K.	Hutton Seam (Beamish)	4	68	4 3
L.	Not yet found.			
M.	Not yet found.			
N.	Not yet found.			
O.	Not yet found.			
P.	Not yet found.			
Q.	Not yet found.			
R.	Not yet found.			
S.	Not yet found.			

It extends over a very limited tract of country, being denudated, and cut off by the river Tyne to the north, and is thrown out to the surface to the south-west and west by a Slip Dyke and the natural rise of the strata. This seam was worked formerly at Monkton and Hebburn Fell; the Coal is of inferior quality, and is interstratified with stone bands. It cannot be wrought to profit at this time.

B. *The Three-quarter Coal.*—This seam is of very uncertain thickness and inferior quality; it has never been worked except partially for land-sale, towards its crop near Haddrick's mill, on the Ouseburn.

C. *The High Main Coal* is the best seam in the district, in point of thickness and quality. It becomes unworkable at a short distance to the south of the Tyne, by being interstratified with a stone called the Heworth band.

The line of the Heworth band runs in the direction of about N. 80° E. by compass. It has been traced from Felling to North Shields, crossing the river three times in that space. The seam extends over a large tract of country to the north, but varies much in thickness and quality in that direction. It is found in the greatest perfection between the river Tyne and the Main Dyke, the seam being thrown so far below the surface (about 190 fathoms) by the Main Dyke, on the north side of Newcastle Town-moor, brings a large tract of it in again, on the dip side of the Dyke, in which the collieries of Fawdon, Coxlodge, Gosforth, Burradon, and Wideopen, are at present working. This tract extends considerably to the west of the meridian of Newcastle. A large tongue or tract of this seam, lying on the south or rise side of the Main Dyke, also runs up to the westward of the meridian of Newcastle, as far as Benwell, where it crops out on the declivity of the hill, leading towards Denton Burn. A great part of the seam in this tract at Benwell and Fenham was destroyed by a conflagration about the middle of the sixteenth century, and the remainder has since been entirely wrought out.

D. *The Metal Coal Seam* is of second-rate quality, and has only been partially worked. In the north-western parts of the district it is not found in a workable state.

E. *The Stone Coal* is not a workable seam in any part of the district at this time, except at Seghill and Cramlington collieries, where it is united with the Metal Coal, the two seams forming there what is called the Grey's Seam.

F. *The Yard Coal Seam* is of inferior quality, with a bad roof, and does not exist as a workable seam in many parts of the district.

G. *The Bensham Seam.*—The Coal is of second-rate quality, with a mixture of scare bands or Slate, and Splint Coal. It is an excellent gas coal, and the splint is in great demand for steam boats and steam engines. The seam does not exist in many parts of the district, particularly in the north-west part.

H. *The Six-quarter Coal* is not workable to profit at this time, in any part of the district; its presence and thickness are both very uncertain.

I. *The Five-quarter Coal.*—The description of the six-quarter Coal applies to this seam also.

K. *The Low Main Seam.*—This seam is not worked at present in any part of this district on the north side of the Tyne, except at Collingwood Main. Wherever it has been worked, it has been found of inferior quality, the coal is tender, and burns to white ashes.

L. *The Crow Coal.*—Not of workable thickness.

M. *The Ryton Five-quarter Coal.*—Not of workable thickness.

N. *The Ryton Ruler Coal,* not of workable thickness.

O. *The Beaumont Seam* is not deemed workable to profit in any part of the district at this period, and has not been found in many parts.

P, Q, R, S, have not yet been found.

RIVER TYNE SUB-DIVISION WEST OF THE MERIDIAN OF NEWCASTLE,

Bounded to the north by the Tyne up to Derwenthaugh and Swalwell, and by the Derwent up to the Hagg; to the west by the crop of the seam a little to the west of Lanchester; and to the south by the Pelton and Beamish Sub-division on the Wear.

A and B cropped out.

C. *The Shield Row Coal* is not workable to profit at present, and only extends over part of the district.

D and E united, forming *The Five quarter Seam.* The seam yields Coal of good second-rate quality, but is wrought out over a great part of the district.

F. *The Brass-thill Seam* yields Coal of second-rate quality; is worked out over a great part of the district.

G, H, I, united, forming *The Hutton Seam.* This is the finest seam in the district. The Coal is rather tender, but of the finest quality, and being free from any admixture of Pyrites, or other foreign matter, it is preferred for all metallic manufactures. This seam has supplied the celebrated "Pitt's Tanfield Moor Coals" for upwards of a century. It is now greatly exhausted.

K. *The Low Main Seam* is not workable to profit at present, although of good quality, on account of the soft and brittle nature of the Coal. Remains entire over a great part of the district.

L. *The Crow Coal* is not found of workable thickness.

M. *The Ryton Five-quarter Coal* is not found of workable thickness.

N. *The Ruler Coal* not of workable thickness.

O. *The Harvey's Low Main*, or *Busty Bank Seam*, is of good second-rate quality; has only been partially worked for land-sale at its crop, in the vale on the south side of the Derwent, and remains entire through the whole district, as far as it has been proved. None of the seams have yet been explored below the Busty Bank Seam in this district. But in the bed of the Derwent, on the west side of the old waggon way bridge, near Gibside, a seam of Coal is to be seen, which I take to be either the Three-quarter, or Brockwell, of the Ryton district, on which it borders. Thus it appears that the south bank of the Derwent, from the summit of Tanfield Moor to the bed of the river at Derwent Bridge, exhibits nearly a complete section of our whole Coal-bearing strata.

THE RYTON AND WALLBOTTLE DISTRICT

Embraces the whole of the Coal-field west of the meridian of Newcastle, on both sides of the Tyne, and north and west of the Derwent.

A, B, C, D, E, F, G, H, I. All cropped out in this district.

K. *The Grand Lease-main Coal Seam* lies through a considerable portion of the district, immediately on the north side of the Main Dyke, owing to the depression of the strata, by the Dyke. It varies much in quality in the different parts of the district, but is mostly of inferior quality; and in many parts it is very bad. It was found in the greatest perfection in Stella Grand Lease, Crawcrook, and Rise-moor Collieries.

L. *The Crow Coal*, not of workable quality and thickness.

M. *The Five-quarter Coal* is of second-rate quality, and has been wrought to a considerable extent in Stella Grand Lease, Crawcrook, and Wylam Collieries.

N. *The Ruler Coal*, not of workable thickness.

O. *Townley Main*, *Barlow Field*, *Upper Main*, or *Engine Seam*, is found through all the district; has been extensively worked, and yields coals of the best second-rate quality.

P. *The Stone Coal*, *Five-quarter Seam*, or *Main Coal*, lies through all the district, is nearly of uniform thickness, but varies in quality and hardness. The coals rank in the second class.

Q. *The Under Five-quarter*, called the *Six-quarter Seam*, at Wylam. The coal is of good quality, but tender, and works small.

R. *The Three-quarter*, or *Yard Seam*, has been worked in Grand Lease and Wylam, but is not found, in a workable state in Walbottle.

S. *The Brockwell*, *Horsley Wood*, or *Splint Coal Seam*, lies through the whole district, yields coal of various qualities in different parts, and has been extensively worked. This is supposed to be the lowest, or last, workable seam, in the series.

RIVER WEAR SUB-DIVISION EAST OF THE MERIDIAN OF CHESTER-LE-STREET. —THE HOUGHTON-LE-SPRING DISTRICT.

A and B not recognised.

C. *The Three-quarter Coal,* is of very inferior quality, and not workable to profit at this time. It has been worked anciently on the south banks of the Wear, near to Pensher Staith.

D and E united, forming the *Five quarter Seam.* This seam yields Coal, of inferior quality, has been extensively worked in some parts of the district, but is not workable to profit, in other parts.

F. *The Upper,* or *High Main Coal Seam;* is generally of good second-rate quality, although it is very bad in some parts. It has been extensively worked.

G. *The Maudlin Seam;* is of good second-rate quality, where the seam is found in a perfect state, but it varies so much in thickness, and is so much interstratified with stone bands, that it is not workable in many parts of the district. This is the character of the Maudlin Seam, throughout the whole extent of the Coal-field, under whatever name it is called. It has been extensively worked in the district, and still produces a large supply of Coals.

H. *The Six-quarter Coal;* is not found in the greater part of the district, and no where in a workable state.

I. *The Low Main Seam;* varies much in thickness and quality, and is *nipped out,* or has not been deposited in some parts of the district. Where found in perfection, it has been extensively worked, but the Coal is of second-rate quality.

K. *The Hutton Seam;* lies through the whole district, and supplies all the best Coals shipped on the Wear. It is this seam which supplies the Stewart's, Lambton's, and Hetton-Wallsend Coals. It has been extensively worked.

L, M, N, have not yet been found in a workable state, and

The Beaumont Seam can hardly be said to be yet known in this district, as it has only been bored to in one or two places, near the banks of the Wear.

RIVER WEAR SUB-DIVISION WEST OF THE MERIDIAN OF CHESTER-LE-STREET. —PELTON DISTRICT.

A and B cropped out.

C. *The Shield Row Seam;* lies through a considerable part of the district, and varies greatly in quality; it is only worked in Beamish Colliery at present.

D and E united, forming *the Five-quarter Seam,* lies through all the district, is variable in quality, but generally yields good second-rate Coals. Has been extensively worked.

F. *The Main Coal, or Brass-thill.* This seam lies through the greater part of the district; the Coal is of second-rate quality, and has been extensively worked.

G. *The Maudlin Seam;* is very uncertain in point of thickness and quality, and has been little worked.

H. Not found.

I. *The Low Main Coal;* extends through the whole district; is an inferior seam, and is not at present worked for sea-sale.

K. *The Hutton Seam.* This seam extends through the whole district, but has only been partially wrought, as the Coal is tender and works small. In some parts it is so interstratified with Stone, Slate, and bad Coal, as not to be workable to profit.

L, M, N, O, P, Q, R, S, not yet explored.

Note.—The Three-quarter, Five-quarter, and Six-quarter Seams, derive their names from their being respectively 3, 5, and 6 quarters of a yard, or 27, 45, and 54 inches thick. A quarter of a yard being the ancient standard of measure used by the Newcastle colliers.

No. I

Section

— from —

JARROW SLAKE to HOLYWELL PIT

Distance by Line of Section 5 Miles 500 Yards

No. II

Section

— from —

RED HEUGH by the SHOT TOWER

MILL PIT ELSWICK COLLIERY EDWARD PIT, BENWELL COLLIERY,

AND ACROSS THE MAIN DYKE *IN DENTON COLLIERY*

Distance by Line of Section 3 Miles 700 Yards

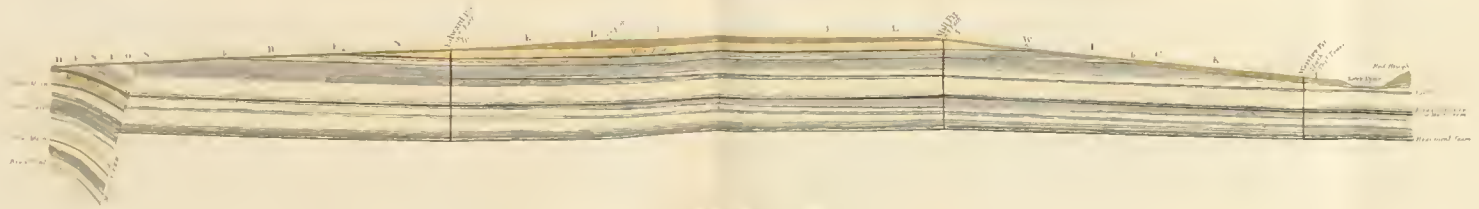


PLATE XVII.

N° III

((Section))

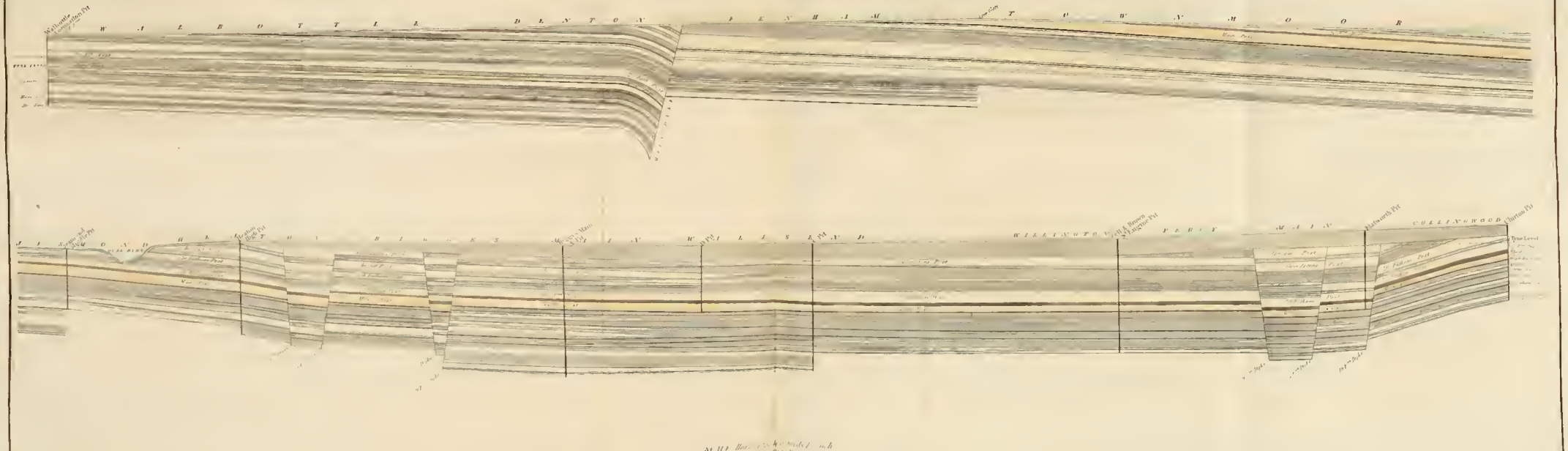
— from —

CHIRTON PIT, COLLINGWOOD MAIN COLLIERY

to the

CORONATION PIT, WILLINGTON COLLIERY.

Distance by Line of Section 10¼ Miles



No IV

((Section))

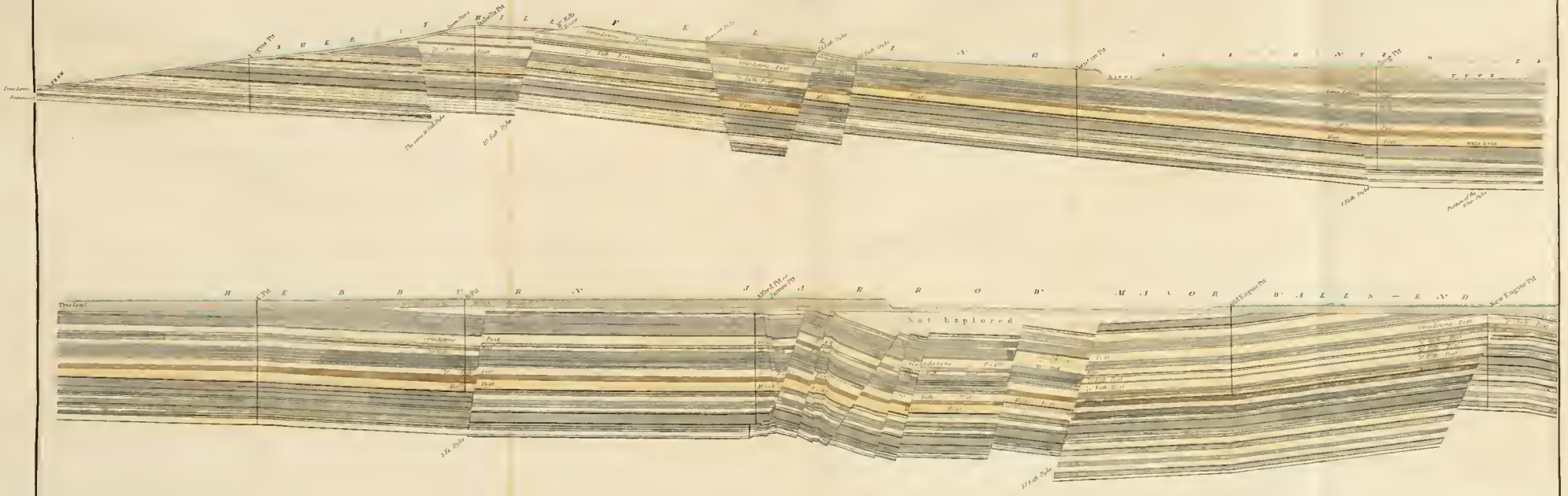
— from —

MANOR WALLS-END NEW ENGINE PIT

to the

RIVER TEAM BELOW SHIREFF HILL ENGINE PIT,

Distance by the Line of Section 9 Miles 1100 Yards



SCALE { Horizontal 400 Yards to an Inch
Vertical 200 Ft Do

No. XXIII.—*Reference to the Sections of the Strata of the Newcastle Coal Field—By John Buddle, Esq.*

Read January 17, 1831.

The horizontal scale of these Sections is 400 yards to an inch, or $4\frac{4}{10}$ inches to a mile. The vertical scale is 200 yards or 100 fathoms to an inch, consequently the apparent angle of declination is double the natural fall of the strata.

The Sand Stone, or Post strata, are coloured yellow; the Argillaceous, or Metal Stone strata, are shaded dark; the seams of Coal are represented by black lines; as are also the Slip Dykes, and the alluvium is represented by a brown shade. The sea-level high water-mark is shewn by a strong dotted line on each section.

No. 1, Plate XXI. Is a section of the strata from the deepest point, (180 fathoms), to which the Main Coal Seam has been worked, under Jarrow Slake, to the Holywell Pit on the north side of the Main Dyke. Its general line of direction is nearly north and south, cutting the Main Dyke nearly at right angles, a little to the north of Prospect Hill, on Shire Moor. This section shews the strata from the Low Main Seam upward, as far as it can be ascertained, by actual sinkings and borings, and by analogy, but a space of about 55 fathoms, including the alluvium under Jarrow Slake, still remains unexplored and unknown. At this lowest point we have nine separate strata of Sand Stone of various thickness, divided by eight groups of Metal Stone of various colour and texture, but the divisions of which cannot be represented on so small a scale.

The following Sand Stone strata, shewn at this point of the section, are the only ones which are distinctly recognizable through every part of the Coal Field, viz.:—The *Main Post*, the *Seventy Fathom Post*, in two or three divisions, and the *Grindstone Post*. Above the Grind-

stone Post is another stratum of Sandstone, 18 fathoms in thickness, which crops out into the diluvium between the Howdon and Percy Pit, and is no more seen on this line of section, except on the dip side of the Main Dyke, where it is *assumed* to have been thrown in again to fill up the chasm occasioned by the depression of the strata on the north side of the Dyke. It is also assumed, that another stratum of Sand Stone of 9 fathoms in thickness overlies this Post, with 11 fathoms of Metal Stone intervening. This is assumed in consequence of those two strata of Sand Stone having been found in sinking the B Pit, at Hebburn, as shewn in Section No. 4.

The Grindstone Post also crops out into the diluvium between the Howdon and Percy Pits, and does not again appear on this line of section, until it is thrown down by the Main Dyke; on the north side of which, at the village of Backworth, it forms the pavement of the street, and is also quarried for building. Beyond this point, the Grindstone Post does not exist on this line of section, as it crops out immediately on the north side of Backworth village.

The Seventy Fathom Post may be considered as comprising all the strata of Sand Stone which intervene between the Grindstone Post and the Main Post. At the lowest point where the section commences, it is in three divisions, separated by two strata of Metal Stone. This post is thrown out by the 40 fathom upcast Dyke to the north, afterwards described, in Collingwood Main Colliery, and does not re-appear on the line of section until we arrive on the north side of the Main Dyke, in Backworth, Earsdon, and Holywell collieries. It crops out before it reaches Holywell Burn, where it is thrown in again by the Briar Dean Burn or 35 fathom Dyke, from whence it probably ranges as far as the river Blyth. It will be observed, that this post is split into five divisions immediately on the north side of the Main Dyke. But two of the divisions become united again before they reach Holywell Pit.

The Main Post.—This Post is thrown out by the 40 fathom upcast Dyke already mentioned, in Collingwood Main Colliery, for the space of 150 yards, where it is thrown in again by an 11 fathom downcast Dyke. It then runs immediately below the soil to Billaw Mill where the

well-known quarry of that name is worked in it. It then runs on the line of the section, and gains cover by the rising of the surface till it approaches the Main Dyke, where by the decline of the ground to the northward of Prospect Hill, and a little to the west of the line of the section it again comes to the surface and is quarried. After its depression by the Main Dyke, it does not again appear at the surface till we find it in the bed of Holywell Burn. I shall not, in this place, notice the Metal Coal Post, and other strata of Sand Stone, which occur below the High Main Coal Seam, an account of their being uncertain in their thickness and character, and because they do not appear at the surface any where on this line of section. The only part in which the Metal Coal Post has been found of any material thickness, is in Jarrow Colliery, where it is 9 fathoms. Through the northern part of the section it never exceeds 2 or 3 fathoms in thickness. To the west of the line, however, at Seghill and Cramlington, this post has been found increased to 10 fathoms.

As to the Argillaceous, or Metal Stone, Strata, I am not at present prepared to state, that they, with the exception of the Black Stone, possess any distinctive character. The Black Stone lies immediately upon the Main Post, from which it is only separated by a thin seam of Coal of 1 to 12 inches, with a fire-clay pavement of from 2 to 4 feet in thickness. The Black Stone itself seldom exceeds 21 feet, but a grey Metal Stone, of variable thickness, is frequently found to repose upon it, and to fill up the space between it and the 70-fathom Post. It is laminated, but compact when dug out, but shivers and decomposes on being exposed to the atmosphere, it is of a deep blueish black colour, and abounds in small bi-valve shells. This Black Stone accompanies the Main Post in every part of the Coal Field, although it is thinner and of a greyer colour in the Tanfield district, and hence a deeper shade has been given to those strata, to guide the eye through the several dislocations. The following seams of Coal are shewn on this section:—The *Monkton*, or *Hebburn Fell Seam*, the *Three-quarter*, the *High Main*, the *Metal Coal*, the *Stone Coal*, the *Yard Coal*, the *Bensham*, the *Five-quarter*, and the *Low Main*.

The Monkton Seam crops into the dilivium, between Howdon and Percy Pit, and does not appear any more on the line of the section, although it may be supposed to be thrown in again on the north side of the Main Dyke, but I am not yet aware that it has been found there.

The Three-quarter Coal is found in Jarrow, Howdon, and Percy Main Collieries, but seems to be *nipped* out, or not to have been deposited in Collingwood Main. It is, however, found again in the collieries on the north side of the Main Dyke; and continues on the line of the section, till it crops out for want of cover, at about half a mile to the north of Holywell Pit.

The High Main Coal is found on every part of the line of section, except for about 150 yards, where it is thrown out into the soil by the 40-fathom Dyke in Collingwood Main Colliery, and for a short space next the Main Dyke, where the seam is nipped out by undulations in the Main Post. This seam varies very much in thickness and character on various parts of the line; and from its having been explored along the whole line of the section, has been taken as the standard for defining the position of the lower seams by analogy, where no sinkings or borings have been made to them.

The Metal Coal, Stone Coal, and *Yard Coal Seams,* lie through the whole line of the section, and are found of various thicknesses and qualities in different places.

The Bensham Seam is found on every part of the line of section.

The Five-quarter Seam lies through every part of the line, but is not workable any where.

The Low Main has only been proved at Jarrow and Collingwood Main, on the line of section, but is known to exist at Whitley, Hartley, and Cowpen.

All the remaining seams of the series are supposed to exist on this line of section, but as they have not yet been proved, they are not represented.

DYKES ON THE LINE OF SECTION, No. 1,

BEGINNING AT THE DEEPEST POINT AT JARROW SLAKE.

The High Main Seam rises for a short distance at an angle of 10°, when it is thrown up to the north by a Dyke 12 feet, and at a short distance further it is thrown up again by another Dyke 6 fathoms. Then just on the south bank of the river Tyne it is thrown down 15 fathoms. The seam then goes on, without interruption, at a moderate rate of rise to about 500 yards north of the Percy Pit, when a sudden degree of ascent takes place, and throws the seam into a sort of ledge for 140 yards. It then stretches away again, at about its ordinary rate of rise, till it is thrown out at the surface by a 40-fathom Slip-dyke, 200 yards to the north of the Chirton Pit.

I shall here pause to notice this 40-fathom Dyke. It has been traced from Willington Colliery through Percy Main and Collingwood Main Colliery—through North Shields and the Black Middens into the sea, below Tynemouth Barracks. It is ascertained to be an up-cast of 40 fathoms to the north in Collingwood Main, but it diminishes in size as it passes through Percy Main and Willington Collieries, towards its junction with the Main Dyke, a little to the north west of the village of Long Benton, behind which it passes. After being thrown out to the surface by this Dyke, the seam is wanting along the line of section for about 150 yards, when it is brought in again by a down-cast Slip-dyke of 11 fathoms. It then proceeds, with very little variation as to level, to the Main Dyke, which throws it down apparently about 140 fathoms. From the north side of the Main Dyke the seam rises rapidly for about half a mile, becoming gradually more level, till at length it becomes nearly flat, and in some places dipping to the north, as is proved by the workings in Holywell and Backworth Collieries. Its next depression is near the village of Holywell, where it is supposed to be thrown down abont 35 fathoms by the Briar Dean-Burn Dyke.

SECTION, No. 2, PLATE XXI.

This section commences at Redheugh, on the south bank of the

Tyne, and passes through Elswick Pit near the Shot Tower, to the pit near to Sinton's Mill, and from thence to the Edward Pit at Benwell, and continues to the north west, across the Main Dyke at about half a mile to the north east of Denton Hall.

This section represents the profile of the surface with tolerable accuracy, and embraces the strata below it as far as the Beaumont Seam. It shews the east and west crop of the Main Post and High Main Coal as they emerge from under the crest of the hill at *a a.*

The Westgate Quarry is worked in the eastern crop of the Main Post; the Fenham Quarry is worked in its western crop. *The Main Coal Seam*, through all its extent, has either been worked or burnt. The seam appears to have been in high perfection through all this tract; as from some patches of it which have been accidentally left, it is ascertained to have been 7 feet thick, and of excellent quality. This proves the fallacy of the generally-received opinion, that the quality of a seam of coal is always deteriorated under a *light* cover.

The Metal Coal also crops out in the declining ground towards both ends of the section at *b b*—it is only from 12 to 18 inches thick.

The Stone Coal is not recognizable through the whole extent of this section, and the Yard Coal is only found to extend as far as the Mill Pit, where it is dwindled to only 16 inches in thickness.

The only trace of the *Bensham Seam* through this line is a Coal of 5 inches in thickness at the Wortley Pit, but there is not the least trace of it in the Mill or Edward Pit, which shews that this seam, as well as the Yard Coal, is nipped out in its progress to the north west. This is the more extraordinary, as these seams are found as usual to the south of this line by the river side.

Near the Shot Tower the *Five-quarter Seam* lies 4 fathoms above the Low Main, here called the Benwell Main Coal. At the Mill Pit they are only 3½ feet asunder, and at the Edward Pit they are united and form a 7-feet seam. These two seams are also united towards the river side, and are now worked together as a 9-feet seam in the pit at the Crooked Billet.

The Low Main Coal lies through the whole extent of the section, but

it undulates so as to form many troughs or swellies. It is also very much infested with *balks*, or ridges of stone, protruding through the roof, and also with hitches.

The *Beaumont Seam* also lies through the whole line. In the vicinity of the Mill Pit it is rendered remarkable by a succession of *nips*, which frequently press the Coal quite out.

The whole series of the seams of Coal, from the High Main downwards, are found again on the north or dip side of the Main Dyke; but all of them are of diminished thickness, except the High and Low Main, and the Beaumont. The continuation of these seams is shewn in Section No. 3.

The most remarkable feature in this (No. 2) Section, is the thick stratum of Sandstone (about 20 fathoms), in which the Yard Coal Seam is embedded. In Section No. 3, it will be seen that this Post begins to be divided by a tongue of Metal Stone under the Town Moor. The upper portion of this Post continues to the east into Wallsend Colliery, gradually thinning in its progress till it forms the band of the Bensham Seam, in the western part of Wallsend Colliery, and runs entirely out under the meridian of Wallsend New Church. The lower division of this Post continues, but of very diminished thickness, through the whole extent of the section to North Shields.

It is further to be remarked, that the same peculiar tendency of the Sandstone beds, to thicken in ther progress westward, is found in the strata below the Low Main as far as the Beaumont; but we have no means of ascertaining whether this tendency continues downwards from that seam to the Brockwell.

There are no Slip Dykes on this line of Section, except such as come under the denomination of hitches, which are much too small to be shewn on this scale.

SECTION No. 3, PLATE XXII.

This Section commences at the Chirton Pit, in Collingwood Main Colliery, as its eastern extremity, and terminates to the west at the Coronation Pit, in Walbottle Colliery, the general line of direction being nearly

east and west. From its commencement at the Chirton Pit, it passes through Flatworth Pit, Willington Bell and Brown Pit, Wallsend C and D Pits, Bigge's Main A Pit, Heaton High Pit, across the Ouse Burn and to Jesmond Middle Pit. Then across the Town Moor to the Cow-gate, through the Fenham division of Benwell Colliery, and across the Main Dyke, at about half a mile north east of Denton-hall, and then in a direct line to the Coronation Pit at Walbottle. The linear direction in this has been better preserved than in any of the other sections. The deepest part of this section is between the two Dykes on the west side of the Flatworth Pit, the High Main Coal there being about 125 fathoms from the surface, bringing in the 18-*fathom Post*, which originates in Jarrow, and is described in Sections No. 1 and 4. Below this we have the *Grindstone Post*, the several divisions of the 70-*fathom Post*, and the *Main Post*.

The *Grindstone Post* continues in from this point to Heaton High Pit, when it crops out and does not again appear further west. To the eastward it crops out before it reaches Chirton Pit.

In describing the various dislocations in this Section, I will take the *Main Post* as my standard. At the Chirton Pit this Post is found in full perfection, at 40 fathoms from the surface, where it is 10 fathoms thick. It dips rapidly, and in an increased ratio from this pit to an 18-fathom down-cast Dyke, at the Flatworth Pit. After being thrown down by this Dyke, it runs, with a very gentle dip, for about 320 yards, where it is again thrown down 5 fathoms. It then goes on, still dipping very gently for 335 yards, where it meets with a 9-fathom upcast. This is the point of the greatest depression, as the strata rise both east and west from it, and answers to the point of the greatest depression under Jarrow Slake, as noticed in Section No. 4. The Main Coal here is only 114 fathoms below the sea level, while under Jarrow Slake it is 152, which shows a rise in the seam of 38 fathoms between the two points in a northerly direction. After passing this 9-fathom upcast, the strata run without interruption, with a gentle rise, through the whole extent of Willington and Wallsend Collieries into Bigge's Main, where they are thrown down by a 9-fathom Slip Dyke to the west. The

full distance being two miles and three quarters, which is the largest stretch of unbroken strata we know of in the district. Although the Main Post and the other strata run through this large extent without interruption or dislocation, it will be observed, that several important changes have occurred in the thickness and divisions of the Sandstone strata.

The *Main Post* gradually thickens from 10 fathoms, at Willington, to 14 at Bigge's Main, while the lower member of the 70-fathom Post, nearly preserves its thickness of 14 fathoms, as far as the D Pit at Wallsend, where it is divided by a thin stratum of Metal Stone. In the east part of Willington we find two thin layers of Sandstone intervening between the lower and upper portion of the 70-fathom Post. But these layers disappear before they reach the C Pit at Wallsend, and the lower one seems to re-appear further to the west in the D Pit, and continues to the 9-fathom Dyke. The upper member of the 70-fathom Post thickens from 4 fathoms to 8 in the whole distance, and it seems to be traversed obliquely by a thin seam of Coal, between the D Pit at Wallsend, and the A Pit at Bigge's Main.

Above the 70 *Fathom Post* an additional stratum of Sandstone occurs to the west, which commences between the C and D Pits in Wallsend, gradually thickens to 12 fathoms in the Bigge's Main Pit, the distance being about three quarters of a mile. Another thin stratum of Sandstone puts in above the upper division of the 70-fathom Post between Willington and Wallsend, and preserves a uniform thickness of about 2½ fathoms, intervening between the above-mentioned *in-put* Post and the Grindstone Post. These two *in-put* strata of Sandstone continue regularly to their out-crop near the Ouse Burn.

It will be observed, that the Metal Coal Post disappears at the 18-fathom Dyke, at the Flatworth Pit, and does not again occur till we find it in the Middle Pit at Jesmond, where it forms the pavement of the Coal. But under the Town Moor it is found to have assumed its proper situation above the seam. Proceeding from this 9-fathom downcast, in Bigge's Main, the strata lie nearly horizontal for about 120 yards, when they are thrown up 8 fathoms. Continuing westward into Heaton Colliery, we meet a 9-fathom downcast, and at 250 yards

further, an upcast of 5 fathoms, which is the last dislocation of any consequence we know of until we arrive at the Main Dyke. The Main Dyke, at this point, is assumed to be about 90 fathoms. The strata on the dip side of the Dyke are drawn from the sinkings and borings in Montagu Main Colliery, and from the sinking account of the Coronation Pit at Walbottle. But as there are no intermediate borings the strata are projected on the Section by drawing the lines between the two points.

SECTION No. 4, PLATE XXIII.

The line of this Section commences at about 400 yards to the east of the St. Hilda or South Shields new Engine Pit, and about three quarters of a mile from the sea. It passes through the old Engine Pit, at the west end of South Shields, along the north side of Jarrow Slake to Jarrow Pit. From this pit, it passes through the Hebburn B and C Pits, crosses through the river obliquely to the King Pit at Walker (where Messrs. Losh and Co.'s soda works are erected), then passes through St. Anthony's Colliery, and re-crosses the river to the Venture Pit, at Felling. From here it runs direct to the Isabella Pit on Gateshead Fell, passing through Felling Colliery. It then changes its direction, and passing through the Sheriff-hill Engine Pit at Low Fell, terminates at the Team. At a future period, it is intended to continue this section through Blackburn Fell, Marley Hill, and Tanfield Moor to Pontop Pike.

The deepest part of this section is under Jarrow Slake, where we have the High Main Coal at 152 fathoms, and the Low Main at 215, below the sea-level high water mark. At this point we have all the strata proved, except about 30 fathoms under the bed of the Slake. Here we have the *Grindstone Post*, the *70-fathom Post*, the *Main Post*, the *Metal Coal Post*, the *Yard Coal Post*, and the *Post lying above the Low Main Coal*, all well defined. We have also, owing to the great depth here, three strata of Sandstone, for which we have no names, as they crop out in South Shields and Hebburn, and, consequently, can not be found on any other part of the line. These extra strata are described in the reference to Section No. 1, but the two lower

beds are united on that line of Section, at the Howdon Pit, and form one stratum of 18 fathoms in thickness.

Commencing at the new Engine Pit, at South Shields, the *Grindstone Post* lies immediately under the Clay, and it does not again appear at the surface on the line of Section till we arrive at the Felling Quarries, near the William Pit, and again in the Grindstone Quarries, on Gateshead Fell, from whence it derives its name.

Commencing at its crop, on Gateshead Fell, and tracing it along the line of the Section to the new Engine Pit, at South Shields, we find it undergoes the following dislocations, depressions, and elevations :— From the quarry, near the Seven Stars, on Gateshead Fell, it runs to the 10-fathom upcast Dyke under Heslop's Pond, where it is thrown out for about 50 yards. But it gains cover again under the crest of the hill, behind Mr. Hall's house, and the dip of the strata, and continues regularly dipping till it reaches the Heworth Dyke, which throws it down about 25 fathoms to the north-east. From this Dyke it goes on without interruption till it meets with an upcast Dyke, in Felling Colliery, of 25 fathoms, which brings it up to the surface again at the High Felling Quarries. The descent of the ground here thins it considerably, and meeting with another upcast Dyke of 16 fathoms, at 250 yards from the former, it is thrown quite off above the surface. But this same Dyke, as will be seen on the Section, throws the first division of the 70-fathom Post up to the level of the Grindstone Post, so that but for the fissure of the Dyke, the first division of the 70-fathom Post might be mistaken for a continuation of the Grindstone Post. From this point to about where our line crosses the river, at Felling Staith, the Grindstone Post is wanting ; but at a little to the dip of this point, it must, from the natural inclination of the strata, be found immediately under the diluvium. It is found in the King Pit, at Walker, at the depth of 35 fathoms, after having been depressed by a small Slip Dyke of 3 fathoms. From the King Pit it runs direct to the B Pit, at Hebburn, without meeting with any material interruption, crossing the line of the Whin Dyke immediately under the bed of the Tyne. Directly on the east side of the B Pit, it is thrown up 5 fathoms by a Slip Dyke,

from whence it proceeds with little interruption to the east side of Jarrow Pit, where it falls in with a succession of Slip Dykes, some throwing up and some down, so as to dislocate the strata for a considerable distance as represented on the Section.

The last Dyke in this succession is an up-throw of 12 fathoms, beyond which the strata rise to the eastward, and bring the Grindstone Post nearly up to the surface in the new Engine Pit at South Shields, as already described. A little further to the eastward, it is thrown quite out by the 40-fathom upcast Dyke; and can only be brought in again further to the east, by the renewed dip of the strata in that direction, as represented.

As the several strata, as well as the seams of Coal, represented in this Section, preserve nearly a parallelism, and are subject to the same inclination and dislocations as the Grindstone Post, the foregoing description of this particular Post, will apply generally to them all, excepting, of course, as to their out-crops.

The *Hebburn Fell Seam* crops out to the eastward near the old Engine Pit at South Shields, and to the westward under the diluvium between the B and C Pits in Hebburn.

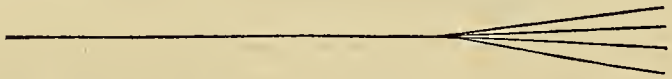
The *Black Stone*, *Main Post*, and *High Main Coal*, run through the whole length of the Section, from South Shields, till they crop out in the declivity of the hill on the east side of the Team near Sheriff-hill Engine. All the seams of Coal, between the High Main and the Beaumont, also rop cout on the east side of the vale of the Team in this part.

The *haids* of the several Slip Dykes, forming the group on the east side of the Jarrow Pit, were ascertained by the driving of two stone drifts, the one immediately below the other, at the distance of 17 fathoms. I merely mention this to shew that the angles, at which those Dykes are represented, may be considered as tolerably accurate.

The only other Dykes of any consequence which occur on this line of Section, are those in Felling and Sheriff-hill Collieries.

Proceeding along our line to the south-west, from the Venture Pit in Felling Colliery, we first meet with a 16-fathom downcast. This Dyke

has been ascertained to be divided into four branches to the eastward, and to run out thus—



What becomes of it to the west is not known.

The next is a downcast of 25 fathoms, which splits into three branches to the eastward, and, like the former, runs out. To the westward it is supposed to be connected with the 16-fathom Dyke.

The next is the Heworth Main Dyke, and is an upcast of 25 fathoms to the south-west. This is a well-known Dyke, having been proved in Dunston Haughs, by the skirt of Whickham Banks, and in Blaydon Main Colliery near to Axwell Park. It is here called the Shipdon Dyke. It then runs in a north-western direction, and crosses the Main Dyke at Stephen's-hall in Townley Main Colliery, but in the crossing, it is changed to a downcast to the south, of 4 fathoms. It then continues its line of direction past the new winning in Crawcrook Colliery, and across the Tyne between Close House and Wylam Colliery, where it increases to 40 fathoms, and brings the seams, which are wanting on its eastern side, down into Wylam Colliery.

The only Dyke which remains to be noticed on this Section is the 10-fathom downcast, to the south, in Sheriff-hill. This Dyke runs in an east and west direction, on the south side of Heslop's Pond; it is simply a Slip Dyke, and does not require any further remark.

It will be observed that this Section deviates materially from a straight line, but I preferred directing its course to those points where the strata had been correctly ascertained by sinkings or borings. Part of the Section is, however, unavoidably filled up by analogy, from the absence of information. I regret that this is the case with respect to Jarrow Pit, the sinking account of which, to the High Main Coal, I have never been able to procure. I have, therefore, been obliged to substitute the strata sunk through in the Hebburn B Pit, which, from its nearness and similar depth, as well as an absence of Dykes between, afforded the best scale I could adopt.

CONCLUDING OBSERVATIONS.

In conclusion, I beg to be permitted to observe, that I merely intend the Sections of our Coal Strata, which accompany this paper, and the descriptions of them, as a partial sketch of the Geology of the Newcastle Coal-field. My immediate object having extended no further than to place the knowledge of the several seams of Coal in a more familiar point of view, than has hitherto been done.

The little which I have done, however, towards illustrating the general formation of the Coal strata of our district, shews, that much more remains to be done, and that the subject forms an extensive field for geological investigation.

I have touched but slightly on the various changes in the Sandstone strata, which occur on the several lines of Section, but it is worthy of observation, that they increase both in number and thickness towards the rise or crop of the strata, and that the number and thickness of the Metal Stone strata increase in the opposite direction. What is the cause of this? Has the law of gravitation operated in the deposition of those strata, and produced this effect? Some light might be thrown upon this branch of the subject, probably, by ascertaining the specific gravities of the several strata at their crop and extreme dip.

The seams of Coal are, in some degree, governed by the same law; as we find some of them, particularly the High Main Coal, thickest towards its crop.

In the series of the seams of Coal which I have given in the table, I have not noticed that described by Mr. Wm. Hutton, under the Red Sandstone at Clowsdon-hill Quarry, on the north side of the Main Dyke, near the village of Killingworth. As this is the Red Sandstone, on which the Magnesian Limestone reposes, there can be no doubt of this seam of Coal, which lies immediately below it, being the first in our series. But as it has not yet been worked in any part of the district, I have not placed it in the Synoptical Table, which is only intended to shew the workable seams in the district.

For a more particular account of this seam, I beg to refer to Mr. Hutton's excellent paper on the New Red Sandstone of the county of Durham, below the Magnesian Limestone, published in the first half volume of the Society's *Transactions*, page 72.

In the description of the several Sections of the strata, I have not entered into detailed descriptions of the several Slip Dykes, which cross their respective lines of direction. I have abstained from this because I am persuaded that the Society will consider the investigation of the several Slip and Whin Dykes which occur in our district, not only a proper subject for geological investigation, but also of great utility to the land and mine proprietors of the present day, as well as to posterity.

As far as our Coal district has been explored, the lines of direction, the throws, and other circumstances of the several Dykes, are well known. But on contemplating the nature of the several seams of Coal, which extend through the district, it is obvious, that, considering their various thicknesses, qualities, and depths from the surface, they cannot be worked in regular succession.

The order of succession in which they will be worked, will be regulated by their relative value—hence, the best and cheapest working seams will be first exhausted. And the seams of inferior thickness and quality, and the most expensive to work, will be the last worked, and each seam will naturally be worked in succession as its relative value as an article of commerce, will entitle it to be carried to market.

It is, therefore, obvious, that many collieries which are now open, will, sooner or later, be shut up, and lie dormant for various and indefinite periods, dependent on, and regulated by, the circumstances above stated And the probability is, that in many cases all knowledge of the Dykes which intersect them may be lost, and that the parties having to re-open them, may be as ignorant, or even more so, than those who first opened these mines.

It is not necessary that I should dwell on the extent of the loss of property and of lives, which may result from such a state of things. My object is to draw the attention of the Society, and of the public, to the means of avoiding it.

Although the several Dykes, which have been met with in all the working collieries of the present day, are accurately represented on the working plans of these collieries, yet from the detached and local nature of those plans, no general and accurate notion of their lines of direction, bendings, and throws, can be formed from such detached sources of information. Nothing can effect the object of gaining an accurate knowledge of this important feature in the geological structure of our district, but the construction of a Map of it, laid down from actual survey, on which all the Dykes which have yet been discovered shall be correctly represented. This Map, to be accompanied by a book of Sections, shewing the throws of the Dykes in every part of the district.

The survey and projection for this Map would serve for the contemplated Geological Map of the district, or, probably, one map might be made to answer both purposes. And as it would form a valuable record for posterity, I submit that the promotion of such an undertaking is worthy of the most serious and prompt consideration of the Society, as well as of the patronage of the landed and mining proprietors of the country.

I, therefore, take the liberty to suggest to the immediate consideration of the Society, the propriety of requesting the Special Committee to prepare a prospectus, and also a report to be submitted to the Society, as to the best mode of proceeding for the attainment of this desirable object.

No. XXIV.—*Extract from a Minute Book on the Explosion at Harraton Colliery, in the Year* 1808.—*By Mr. Matthias Dunn.*

Read, February 21, 1831.

November 29.—In consequence of an accident having happened to the machinery of the 6th Pit, then working in the Hutton seam, sixteen of the men and boys started to travel through the old workings to the Row Pit, where they expected to be drawn up, and as the air in the drifts through which they were to pass was very violent, they carried with them a torch or *lowe-rope*. As they were strangers to the innumerable windings of the road, they straggled out of the regular air course and into the vicinity of a pair of frame dams, which shut off a considerable tract of old workings charged with inflammable air. These dams, inserted in a pair of drifts each 9 feet wide, were constructed of endways Memel balks, in lengths of 5 or 6 feet, lined with slit deal and wedged air tight, but were not supplied with a discharging cock as the experience of later times would have suggested. A leakage of inflammable air from these dams having accumulated in the neighbouring workings into which they were then entering, an explosion was immediately the consequence. Such of the people as were slightly injured succeeded in finding their way to the Row Pit, but the greater number being more seriously burnt or otherwise injured, were left to their fate. The leakage of inflammable air from the dams continued to supply fuel for several successive explosions, at lengthened intervals, of so general a nature, that their effects were felt at the top of the working pit, although half a mile distant. As soon as the explosions seemed to have subsided, Thomas Defty, the overman, and others, went down in search of the unfortunate people, some of whom were dead, others grievously burnt; but scarcely had they reached the vicinity of the dams, when

another unexpected explosion took place, which killed Defty and two of his companions, for it now turned out that fire must all along have existed at the dams.

November 30.—At 2 A. M., having raised a considerable party, we penetrated to the fatal spot, and succeeded in recovering all the bodies but one, some of whom were very little burnt.

December 1.—The body of the absent boy, Peel, was found this morning. In consequence of the deranged state of the waste between the pits, it was found impossible to penetrate through the *after-damp*, with which it was filled, to examine the dams, nor ascertain the state of matters about the working pit, in the stables of which were 22 horses. The smoke of the upcast pit seemed to portend the existence of fire, it was, therefore, judged imprudent to risk lives in any further attempt, but to scaffold over both pits as the only safe mode of extinguishing the fire.

December 5.—The scaffolds were accordingly completed, with a covering of clay 6 feet thick, that in the working pit being furnished with a wooden box fitted up with a moveable lid, for the purpose of easing the pressure, and ascertaining from time to time, the state of the air and smoke.

January 19, 1809.—More than six weeks having elapsed since the closing of the shafts, the re-opening commenced this day by easing the box at the upcast pit. The air seemed much compressed, was at a high temperature, and rankly putrid, from the dead bodies of the horses. Both scaffolds were opened during the day, and suffered to remain so until

January 21.—Little or no change being perceptible at the upcast pit, it was determined to examine the state of matters underground by descending the downcast pit and travelling through the workings. On reaching the neighbourhood of the dams, considerable intimidation was felt lest any fire should yet exist, and which was not a little heightened by a recollection of the dreadful scene which had so short a time before taken place.

The dams, however, were found quite safe, but some of the timbers

slid an end by the violence of the pressure, which was corroborated by the devastation observable all around, and especially about the bottom of the working pit. As the deranged state of the ventilation precluded the use of candles, and as at this period the invaluable safety lamp of Sir H. Davy was not invented, we were obliged to have recourse to steel mills.

About the pit bottom and in the stables the fire seemed to have been uncommonly severe, the horses being in a great measure roasted, and hurled into the most frightful positions. After passing through the stables, where all seemed undistinguished destruction, we were not a little surprised at a snort, the paddling of feet, and a familiar neigh, from one of the ponies, which scampered off at our approach. Owing to a trick of slipping his collar, he seems to have been out of the stables at the time of the explosion, and thereby saved his life; the narrowness of his escape may be guessed from the singed state of both his mane and tail. Part of the hay had escaped destruction, which, with the water falling down the shaft, supported him in prime condition. As little or no fire seems to have existed at the period of shutting up the pit, and as the workings were extended over some hundreds of acres, no want of respirable air would be felt. The pony was preserved for many years afterwards.

No. XXV.—*A Catalogue of the Birds hitherto met with in the Counties of Northumberland and Durham.* By P. J. Selby, Esq., F. R. S. E., F. L. S., M. W. S. &c. &c.

Read, February 21, 1831.

Ordo. Raptores.
Fam. Falconidæ.
Subfam. Aquilinæ.
Genus AQUILA. EAGLE.

1. AQUILA CHRYSAËTOS. GOLDEN EAGLE.

Falco Chrysaëtos, *Flemm.* Br. Anim. *Selby's* Illus. Br. Orn.

Adult.
- Falco chrysaëtos, *Linn.*, *Lath.*, *Raii*, *Briss.*
- Aigle Royal, *Temm.* Man. d'Ornith.
- Golden Eagle, *Penn.* Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

Young.
- Falco fulvus. *Linn.*, *Lath.*, &c.
- Ring-tailed Eagle, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

This noble species rarely leaves the mountainous districts of Scotland, and very few instances of its capture in the Lowlands, or the borders of England, are upon record. Bewick, however, mentions a very large one killed near Warkworth, which measured eleven feet in extent of wing. The Ring-tailed Eagle of authors is now perfectly ascertained to be the young or immature bird of this species.

Genus HALIAËTOS. SEA EAGLE.

2. HALIAËTOS ALBICILLA. CINEREOUS SEA EAGLE.

Falco albicilla, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.
Aigle Pygargue, *Temm.* Man. d'Ornith.

Adult.
- Falco albicilla, *Linn.*, *Lath.*, &c.
- White-tailed Eagle, *Will.*, *Bewick's* Br. Birds.
- Cinereous Eagle, *Penn.* Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict.

Young.
- Falco ossifragus, *Linn.*, *Lath.*, *Raii.*
- Falco Melanaëtos, *Lath.*, *Will.*
- Sea Eagle, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

Several individuals of this species have, at various times, been killed in Northumberland

and the adjoining counties. A few years ago, three were shot in Chillingham Park, where they were accustomed to feed upon the fallen deer; and in the winter of 1828, two immature birds (one of which is now in my collection) were killed upon the coast, one at Holy Island, the other upon the shore at Scremmerstone, near Berwick. Another was lately killed in the neighbourhood of Morpeth, and during the past winter, a very large bird of this species, haunted Holy Island, and the adjoining coast.

Genus PANDION. OSPREY.

3. PANDION HALIAËTOS. COMMON OSPREY.

Falco haliaëtos, *Linn.*, *Lath.*, *Selby*, &c.
Aigle Balbuzard, *Temm.* Man. d'Ornith.
Osprey, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

A fine specimen of this bird, in the possession of H. Hewitson, Esq. of Seaton Burn, was shot at Prestwick Car; another in the collection of Messrs. Hancock, was shot near Hartley, and I am informed that Mr. E. Backhouse, when at Hartlepool, frequently saw one perched upon the wreck of a ship.

Subfam. Accipitrina.

Genus ACCIPITER. HAWK.

4. ACCIPITER NISUS. SPARROW HAWK.

Falco Nisus, *Linn.*, *Lath.* &c.
L'Epervier, *Temm.* Man. d'Ornith.
Sparrow Hawk, Br. Zool., Arct. Zool., *Lath.* Syn., Mont. Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

A very common species.

Subfam. Falconina.

Genus FALCO. FALCON.

5. FALCO ISLANDICUS. GYR-FALCON.

Falco Islandicus, *Selby's* Illus. Br. Orn.
Gyrfalco candicans, *Flemm.* Br. Anim.

Adult.
- Falco Islandicus candicans, *Lath.* &c.
- White Jerfalcon, *Lath.* Syn., Br. Zool.

Young.
- Falco Gyrfalco, *Lath.*, &c.
- Falco Sacer, *Gmel.*
- Iceland Falcon, Arct. Zool., *Lath.* Syn.
- Jer-falcon, *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

A very rare British Bird. A female now in the Museum of the Society, was shot in Northumberland.

6. FALCO PEREGRINUS. PEREGRINE FALCON.

Falco peregrinus, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.
Faucon pelerin, *Temm.* Man. d' Ornith.

Adult. { Falco peregrinus, *Lath.*, *Raii*, &c.
Peregrine Falcon, Br. Zool., *Lath.* Syn., *Mont.* Ornith., Dict., *Bewick's* Br. Birds

Immature. { Falco communis, *Lath.*, *Briss.*, &c.
Black, Red, and Red Indian Falcon, *Lath.* Syn.

This species is not uncommon, and several specimens are annually killed in the northern counties. They build in the face of crags, old towers, &c.

7. FALCO SUBBUTEO. HOBBY FALCON.

Falco subbuteo, *Linn.*, *Lath.*
Faucon hobereau, *Temm.* Man. d'Ornith.
Hobby, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

A rare species in the north. A female now in the Museum of the Messrs. Hancock, of Newcastle, was shot at Streatlam Park.

8. FALCO ÆSALON. MERLIN.

Falco Æsalon, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.
Faucon Emerillon., *Temm.* Man. d'Ornith.

Adult. { Falco litho-Falco, *Lath.*, *Raii*, &c.
Stone-Falcon, *Lath.* Syn., *Mont.* Ornith. Dict. App. to Sup.

Fem. & Young. { Falco Æsalon, *Lath.*, *Raii*, &c.
Merlin, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, &c.

This species breeds upon our moors. The nest is placed upon the ground, frequently on the sides of hills, among stones and broken ground. In addition to several at Twizell, I may mention a pair killed from the nest in the summer of 1824, near Blagdon.

9. FALCO TINNUNCULUS. KESTREL.

Falco tinnunculus, *Linn.*, *Lath.*, *Flemm.*, *Selby.*
Faucon cresserelle, *Temm.* Man. d'Ornith.
Kestrel, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, &c.

Subfam. Buteonina.

Genus Circus. HARRIER.

10. CIRCUS RUFUS. MARSH HARRIER.

Falco rufus, *Selby.*
Buteo æruginosus, *Flemm.* Br. Anim.
Busard harpaye, *Temm.* Man. d'Ornith.

Old. { Falco rufus, *Linn.*, *Lath.* &c.
Circus rufus, *Briss.*
Harpy Falcon, *Lath.* Syn.

Young. { Falco æruginosus, *Linn.*, *Lath.* &c.
Le Busard de marais, *Buff.* Ois.
Moor Buzzard, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

This species is not uncommon throughout the northern counties, in low and marshy districts. It breeds annually at Newham Lough, making its nest upon some large hassock in the middle of reeds and other aquatic herbage. In the breeding season it soars to a considerable elevation, its flight at other times is low.

11. CIRCUS CYANEUS. HEN HARRIER.

Circus cyaneus, *Flemm.* Br. Anim.

Old and Middle-aged Male.
- Falco cyaneus, *Linn.*, *Lath.* &c.
- Busard St. Martin, *Temm.* Man. d'Ornith.
- Hen Harrier, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

Female and Young.
- Falco Pygargus, *Linn.*, *Lath.* &c.
- La Soubuse, *Buff.* Ois.
- Ring Tail, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

Not uncommon, and a very destructive species to game. Roosts upon the ground in very long heath or ling, and generally in companies of 5 or 6 together, males and female indiscriminately.

12. CIRCUS CINERARIUS. ASH-COLOURED HARRIER.

Falco cinerarius, *Mont.* Ornith. Dict. and Sup., *Selby's* Illus. Br. Orn.
Buteo cineraceus, *Flemm.* Br. Anim.
Busard montagu, *Temm.* Man. d'Ornith.
Ash-coloured Falcon, *Mont.*
Ash-coloured Harrier, *Selby.*
Ash-coloured Buzzard, *Flemm.*

A species of very rare occurrence in Britain. In my collection are two specimens, one of which was killed near Morpeth, the other was shot near Twizell, on the 12th of August, 1819, when skimming rapidly past me. Both of these specimens are males in mature plumage. Another specimen in the possession of Mr. Featherston, of Newcastle, was shot at Allen Heads, county of Durham.

Genus PERNIS. HONEY BUZZARD.

13. PERNIS APIVORUS. EUROPEAN HONEY BUZZARD.

Pernis apivorus, *Flemm.* Br. Anim.
Falco apivorus, *Linn.*, *Lath.*, *Raii.*
Buse bondrée, *Temm.*
Honey Buzzard, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

This is one of the rarest and most elegant of the British Falconidæ. A very fine male was killed in September, 1829, by the gamekeeper of the Hon. H. T. Liddell, of Eslington House, at Thrunton Wood; when dissected, it was found gorged with the larvæ of Wasps, and was remarkably fat. Another is mentioned by Mr. Trevelyan, of Wallington, as having been killed some years ago in that neighbourhood; it is now in the Ashmolean Museum at Oxford. The weak Bill and strait Claws of this bird, indicate a departure from the strictly predatorial habits of the more typical Falconidæ.

Genus BUTEO. BUZZARD.

14. BUTEO VULGARIS. COMMON BUZZARD

Buteo vulgaris, *Flemm.* Br. Anim.
Falco vulgaris, *Linn.*, *Lath*, &c.
La Buse, *Temm.* Man. d'Ornith.

Common Buzzard, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

In the northern counties of England the Buzzard cannot be considered, as a common species. I have occasionally met with it during summer in the neighbourhood of the Cheviots. In the hilly districts of Selkirk, Dumfries, and Peebleshire, it is very numerous during the breeding season, and almost every precipitous dell or rock contains an eyry.

15. BUTEO LAGOPUS. ROUGH-LEGGED BUZZARD.

Buteo Lagopus, *Flemm.* Br. Anim.
Falco Lagopus, *Linn.*, *Lath.*
Buse pattue, *Temm.*
Rough-legged Buzzard, *Selby's* Illus. Br. Orn.
Rough-legged Falcon, *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds Sup.

This fine species is only an occasional and rare visitant. In the autumn and winter of 1815, several visited the northern counties, and I was fortunate in procuring several specimens. A specimen in the Museum of the Society was killed at Marsden Rocks, near Sunderland, county of Durham.

Subfam. Milvina.

Genus. MILVUS. KITE.

16. MILVUS VULGARIS. COMMON KITE.

Milvus vulgaris, *Flemm.* Br. Anim.
Falco Milvus, *Linn.*, *Lath.* &c.
Milan Royal, *Temm.*
Kite, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

A rare species in Northumberland and Durham, but frequently met with in Cumberland and Westmorland.

Fam. Strigidæ.

Subfam. Noctuina.

17. NOCTUA ERMINEA. SNOWY OWL.

Strix nyctea, *Lath.*, &c.
Chouette harfang, *Temm.* Man. d'Ornith.
Snowy Owl, Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

This magnificent species is a very rare and occasional visitant. Two fine specimens now in my collection were killed in Northumberland, in January, 1823. The female at Rothbury, and the male a few days afterwards, in the neighbourhood of Elsdon.

18. NOCTUA TENGMALMI. TENGMALM'S OWL.

Strix Tengmalmi, *Linn.*, *Gmel.*
Chouette Tengmalm, *Temm.*
Strix passerina, *Selby's* Illus. Br. Orn.
Little Owl, *Ibid.*

At the time the figures of the British Strigidæ, were published in the "*Illustrations of British Ornithology*," I had not been able to make the necessary comparison between the closely allied species, Noctua Tengmalmi, and Noctua passerina, and in consequence I have attached the synonymes of the true Strix passerina of authors, to a bird, which, upon further investigation, proves to be the Strix Tengmalmi of Temminck and others. The specimen, from which my figure was taken, and which still remains in my collection, was killed near to Morpeth, in 1812, a fact, however, which also entitles it to be placed upon the list of our native Fauna, as an occasional visitant. It differs from Noctua passerina, in having the plumage of the upper parts of the body of a deeper brown, the tail considerably longer, compared with the length of the wings, a black mark between the bill and the eyes, and the legs and *toes* thickly clothed with soft downy feathers.

Subfam. Asionina.

Genus OTUS. HORN OWL.

19. OTUS VULGARIS. LONG-EARED HORN-OWL.

Otus vulgaris, *Flemm.* Br. Anim.
Strix Otus, *Linn.*, *Lath.*, &c.
Hibou moyen Duc, *Temm.* Man. d'Ornith.
Long-eared Owl, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

A common species, and very generally dispersed in all wooded districts.

20. OTUS BRACHYOTOS. SHORT-EARED HORN-OWL.

Otus brachyotos, *Flemm.* Br. Anim.
Strix brachyotos, *Linn.*, *Lath.*
Hibou brachiôte, *Temm.* Man. d'Ornith.
Short-eared Owl, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

Common during the period of their migrations. I am inclined to think, that a few pairs occasionally breed upon the higher Moors in Northumberland, as I have repeatedly met with old birds during the summer months, and also on the 12th of August, at which time they were in the moult. Sir. Wm. Jardine has ascertained that they breed annually in certain mosses, upon the moors in Dumfries-shire.

Subfam. Strigina.

Genus SYRNIUM. HOWLET.

21. SYRNIUM ALUCO. TAWNY HOWLET.

Strix stridula, *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.
Chouette hulotte, *Temm.* Man. d'Ornith.

Male. { Strix Aluco, *Linn.*, *Lath.*
Aluco, *Will.*
Brown Owl, *Penn.* Br. Zool.

Female. { Strix stridula, *Linn.*, *Lath.* &c.
Tawny Owl, Br. Zool., *Lath.* Syn., *Mont.* &c.

Common in all wooded districts.

Genus STRIX. OWL.

22. STRIX FLAMMEA. BARN OWL.

Strix flammea, *Linn.*, *Lath.*, &c.
Aluco flammea, *Flemm.* Br. Anim.
Chouette effraie, *Temm.* Man. d'Ornith.
White Owl, Br. Zool., *Mont.* Ornith. Dict., *Bewick*, *Selby*, &c.

Ordo Insessores.

Tribus 1. Fissirostres.

Fam. Hirundinidæ.

Genus CYPSELUS. SWIFT.

23. CYPSELUS APUS. COMMON SWIFT.

Cypselus apus, *Flemm.* Br. Anim.
Cypselus murarius, *Temm.* Man. d'Ornith.
Hirundo apus, *Linn.*, *Lath.* &c.
Swift, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

Genus HIRUNDO. SWALLOW.

24. HIRUNDO RUSTICA. CHIMNEY SWALLOW.

Hirundo rustica, *Linn.*, *Lath.*, &c.
Hirondelle de Cheminée, *Temm.* Man d'Ornith.
Chimney, or Common Swallow, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., &c.

25. HIRUNDO URBICA. MARTIN.

Hirundo urbica, *Linn.*, *Lath.*, &c.
Hirondelle de Fenêtre, *Temm.* Man. d'Ornith.
Martin or Martlet, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

26. HIRUNDO RIPARIA. SAND MARTIN.

Hirundo riparia, *Linn.*, *Lath.*, *Raii.*
Hirondelle de Rivage, *Temm.* Man. d'Ornith.
Sand Martin, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Fam. Caprimulgidæ.

Genus CAPRIMULGUS. GOATSUCKER.

27. CAPRIMULGUS EUROPÆUS. EUROPEAN GOATSUCKER.

Caprimulgus europæus, *Linn.*, *Lath.*, *Raii*, &c.
L'Engoulevent ordinaire, *Temm.* Man. d'Ornith.
European Goatsucker, Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.
Night Jar, *Bewick's* Br. Birds.

Not uncommon in retired woody dells, moors, and commons, abounding in fern beds. Makes no nest, but lays its two oblong eggs upon the bare ground. Makes its appearance about the middle of May, and does not leave the island till the beginning of October.

Fam. Halcyonidæ.

Genus ALCEDO. KING'S-FISHER.

28. ALCEDO ISPIDA. COMMON KING'S-FISHER.

Alcedo Ispida, *Linn.*, *Lath.*, *Raii.*
Martin-Pêcheur Alcyon, *Temm.* Man. d'Ornith.
King's-Fisher, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm.* Br. Anim.

Upon the Wansbeck, about Mitford and the Angerton Meadows, the King's-Fisher is common and permanently resident, and I have procured the nest and eggs from both these places. It is also not unfrequently seen upon the Ouse Burn, near Newcastle. Upon the river Wear, about Chester-le-Street, it is well known, and a nest with eggs, was taken in that neighbourhood last summer. Its flight is very rapid and direct.

Tribus 2. Dentirostres.

Fam. Muscicapidæ.

Genus MUSCICAPA. FLYCATCHER.

29. MUSCICAPA GRISOLA, SPOTTED FLYCATCHER.

Muscicapa grisola, *Linn.*, *Lath.*, &c.
Gobe-mouche gris, *Temm.* Man. d'Ornith.
Spotted Fly-catcher, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

One of our latest summer visitants, seldom arriving before the middle of May.

30. MUSCICAPA ATRICAPILLA. PIED FLY-CATCHER.

Muscicapa atricapilla, *Gmel.*, *Lath.*
Mus. luctuosa, *Temm.* Man. d'Ornith.
Pied Fly-catcher, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

In Northumberland and Durham, this species is of rare occurrence, but in Westmorland and parts of Cumberland, it is well known as a summer visitant, particularly in the neighbourhood of Penrith and Ulswater. It breeds in the holes of decayed pollard trees, making scarcely any nest, a few oak leaves and a stalk or two of grass, being all the material collected. The eggs are 5 or 6 in number, of a beautiful greenish-blue colour. Its habits are very similar to those of the Muscicapa grisola.

Fam. Laniadæ.

Subfam. Laniana.

Genus LANIUS. SHRIKE.

31. LANIUS EXCUBITOR. GREAT CINEREOUS SHRIKE.

Lanius excubitor, *Linn.*, *Gmel.*, *Lath.*
Pie-grièche grise, *Temm.*
Great Cinereous Shrike, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

The visits of this species appear to be very irregular, some winters passing without the

appearance of a single individual, whereas in others, it is by no means uncommon. This irregularity is very probably occasioned by the state of the weather at the period they undertake their equatorial migration from the northern counties of Europe, an adverse wind driving them out of their direct and usual course.

32. LANIUS COLLURIO. RED-BACKED SHRIKE.

Lanius colluri *Linn.*, *Lath.*
Pie-grièche [illegible]heur, *Temm.* Man. d'Ornith.
Red-backed [illegible], Br. Zool., *Lath.* Syn., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

This species though common in many parts of England, is rare in the northern counties. A male and female were killed upon the Town Moor, Newcastle, about three years ago; and another pair by Lord Ravensworth's gamekeeper, at Ravensworth Castle, in the county of Durham, where they had their nest.

Fam. Merulidæ.

Subfam. Merulina.

Genus TURDUS. THRUSH.

33. TURDUS VISCIVORUS. MISSEL-THRUSH.

Turdus viscivorus, *Linn.*, *Lath.*, *Raii.*
Merle draine, *Temm.* Man. d'Ornith.
Missel-Thrush, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

This species within the last 10 or 15 years, has become very common in the northern counties.

34. TURDUS PILARIS. FIELDFARE.

Turdus pilaris, *Linn.*, *Lath.*, *Raii.*, &c.
Merle litorne, *Temm.* Man. d'Ornith.
Fieldfare, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

35. TURDUS MUSICUS. SONG THRUSH.

Turdus musicus, *Linn.*, *Lath.*, *Raii.*
Merle grive, *Temm.* Man. d'Ornith.
Throstle or Song Thrush, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.
Common Thrush, *Flemm.* Br. Anim.

36. TURDUS ILIACUS. REDWING THRUSH.

Turdus iliacus, *Linn.*, *Lath.*, *Raii.*
Merle mauvis, *Temm.* Man. d'Ornith.
Redwing, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn.
Redwing Thrush, *Flemm.* Br. Anim.

This is one of our earliest winter visitants, and generally appears several weeks before the Fieldfare.

37. TURDUS MERULA. BLACKBIRD.

Turdus merula, *Linn.*, *Lath.*, *Raii.*, &c.
Merle noir, *Temm.* Man. d'Ornith.
Blackbird, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

In addition to our indigenous birds, numerous flocks of Blackbirds and Thrushes, visit us annually for a few days, during the course of their autumnal migration from the north of Europe to more southern latitudes. The time of their appearance is generally between the 10th and 20th of November.

38. TURDUS TORQUATUS. RING OUZEL.

Turdus torquatus, *Linn.*, *Lath.*, &c.
Merle á plastron, *Temm.* Man. d'Ornith.
Ring Ouzel, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.
Ring Thrush, *Flemm.* Br. Anim.

A summer periodical visitant, common throughout the Cheviot range, and the higher parts of Cumberland and Durham.

Genus CINCLUS. DIPPER.

39. CINCLUS AQUATICUS. EUROPEAN DIPPER.

Cinclus aquaticus *Bechst.*, *Selby*, *Flemm.*
European Dipper, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.
Sturnus cinclus, *Linn.*
Turdus cinclus, *Lath.* Ind. Orn.
Cincle plongeur, *Temm.* Man. d'Ornith.
Water Ouzel, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

Common upon all our mountain rivulets. In winter it descends to the larger rivers.

Subfam. Oriolina.

Genus ORIOLUS. ORIOLE.

40. ORIOLUS GALBULA. GOLDEN ORIOLE.

Oriolus galbula, *Linn.*, *Lath.*
Loriot, *Temm.* Man d'Ornith.
Golden Oriole, Br. Zool. Appx., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Sup. Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

A very rare and occasional visitant. The only authenticated instance of its capture in Northumberland, that I have heard of, is that of a female killed in a garden at Tynemouth, in the spring of 1821.

Fam. Sylviadæ.

Subfam.

Genus. ACCENTOR. ACCENTOR.

41. ACCENTOR MODULARIS. HEDGE ACCENTOR.

Accentor modularis, *Cuv.* Reg. Anim., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.
Hedge Accentor, *Selby*, *Flemm.*

Sylvia modularis, *Lath.* Ind. Orn.
Accenteur mouchet, *Temm.* Man. d'Ornith.
Hedge Sparrow, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict.
The Winter Fauvette, *Bewick's* Br. Birds.

Subfam. Lusciniana.

Genus SALICARIA.

42. SALICARIA LOCUSTELLA. GRASSHOPPER WARBLER.

Salicaria locustella, *Selby.*
Sylvia locustella, *Lath.* Ind. Orn.
Bec-fin locustelle, *Temm.* Man. d'Ornith.
Grasshopper Warbler, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *White's* Hist. Selb., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

The Grasshopper Warbler is but sparingly dispersed, and only in peculiar localities, low, shrubby underwood in moist situations appears to be their favourite resort. At Twizell, when the plantations were young, with a great undergrowth of broom, whin, and bramble, they were, I may say, numerous, but since the wood has grown up, they have deserted the place. The eggs of this species are not of a blueish white, as stated in the *Illustrations*, but of a pinkish-grey, with numerous small specks of a deeper colour.

43. SALICARIA PHRAGMITIS. SEDGE-WARBLER.

Salicaria Phragmitis, *Selby.*
Curruca Salicaria, *Flemm.*
Sylvia Phragmitis, *Bechst.*
Sylvia Salicaria, *Lath.*
Bec-fin phragmite, *Temm.* Man. d'Ornith.
Sedge Warbler, Arct. Zool., *Lath.* Syn., *White's* Hist. Selb., *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn.

This is a very common species in all low situations, the banks of rivers, ponds, &c. It sings during the greater part of the night, and may at any time be induced to utter its song, by throwing a stone into the bush in which it sits concealed from view: many of its notes resemble those of other small birds, as the Swallow, Sparrow, &c.

Genus CURRUCA.

44. CURRUCA ATRICAPILLA. BLACK-CAP WARBLER.

Curruca atricapilla, *Flemm.* Br. Anim.
Sylvia atricapilla, *Lath.*
Bec-fin à tête noir, *Temm.* Man. d'Ornith.
Black-cap, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.
Black-cap Warbler, *Selby's* Illus. Br. Orn.

This delightful songster is not uncommon in wooded situations, dells, &c.

45. CURRUCA HORTENSIS. PETTY-CHAPS WARBLER.

Curruca hortensis, *Flemm.* Br. Anim.
Sylvia hortensis, *Lath.*
Bec-fin fauvette, *Temm.* Man. d'Ornith.
Greater Petty-chaps, *Mont.* Ornith. Dict., *Selby's* Illus. Brit. Orn., *Flemm.* Br. Anim.

Inhabits the same localities as the Black Cap, which it emulates in the richness and depth of its notes. I have frequently met with it in the Highlands of Scotland, particularly about Killin and Loch Awe.

46. CURRUCA CINEREA. WHITE-THROAT WARBLER.

Curruca cinerea, *Flemm.* Br. Anim.
Sylvia cinerea, *Lath.*
Bec-fin grisette, *Temm.* Man. d'Ornith.
White-throat, Br. Zool., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

47. CURRUCA SYLVIELLA. LESSER WHITE-THROAT WARBLER.

Curruca sylviella, *Flemm.* Br. Anim.
Sylvia sylviella, *Lath.*
Sylvia curruca, *Temm.* Man. d'Ornith., *Lath.?*
Bec-fin babillard, *Temm.* Man. d'Ornith.
Lesser White-throat, *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm.* Br. Anim., *Bewick's* Br. Birds, Sup.

This species is rare in the north of England. Specimens have been killed in the neighbourhood of Newcastle; and Mr. Wm. Procter, of Durham, has also found it in the vicinity of that city. He met with two nests, both of them containing young. The nest is composed principally of Goose-grass (Galium Aparine). When alarmed, the note-call is similar to the word *chat*, frequently repeated. It is a shy bird, and specimens are not easily procured, as it conceals itself in the thickest bushes, and runs like a mouse from one part to another.

48. CURRUCA SUECICA. BLUE-THROATED WARBLER.

Sylvia suecica, *Lath.* Ind. Orn.
Bec-fin gorge bleue, *Temm.* Man. d'Ornith.
Blue-throated Warbler, *Lath.* Syn., Arct. Zool.

A beautiful specimen of this Warbler was shot upon Newcastle Town-moor, and is now in the Museum of the Society.

Genus RUTICILLA. REDSTART.

49. RUTICILLA PHŒNICURUS. COMMON REDSTART.

Sylvia phœnicurus, *Lath., Flemm., &c.*
Rutacilla, *Raii.*
Bec-fin de murailles, *Temm.* Man. d'Ornith.
Redstart, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

Not uncommon in certain localities, particularly where stone walls and very old trees abound. This bird forms the type of a well-marked group, on which account I have separated it from the Genus Curruca. The different species referable to the genus are all very like each other, and are distinguished by having the tail of a reddish brown colour. A second species of the genus has recently been added to the list of our Fauna, viz. the Ruticilla Tithys, Sylvia Tithys of Scopoli. This and the following genus are very closely allied to the Saxicolinæ, and might, perhaps with equal propriety, be included in that sub-family.

Genus SIALIA.

50. SIALIA RUBECULA. REDBREAST.

Sylvia rubecula, *Lath.*, *Flemm.*, *&c.*
Motacilla rubecula, *Linn.*
Bec-fin rouge-gorge, *Temm.* Man. d'Ornith.
Redbreast, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

Subfam. Sylviana.

Genus SYLVIA.

51. SYLVIA TROCHILUS. YELLOW WILLOW WREN.

Sylvia trochilus, *Lath.*, *&c.*
Le Pouillot, *Buff.*
Bec-fin à poitrine jaune, *Temm.* Man. d'Ornith.
Yellow Wren, Br. Zool., *Lath.* Syn., *Mont.* Orn. Dict., *Selby's* Illus. Br. Orn.

A very common and numerous species in the northern counties; arrives between the 8th and 16th of April. The nest is lined with feathers.

52. SYLVIA SIBILATRIX. WOOD WREN.

Sylvia sibilatrix, *Bechst.*, *Flemm.*, &c.
Sylvia sylvicola, *Lath.* Ind. Orn. Sup.
Bec-fin siffleur, *Temm.* Man. d'Ornith.
Wood Wren, Trans. Linn. Soc. v. ii. 245, t. 24., *Lath.* Syn., *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn.

Common in all wooded situations, particularly where oak or elm abounds; does not arrive till the beginning of May. Nest lined *with hair and fine grass.*

53. SYLVIA HIPPOLAIS. LESSER PETTYCHAPS.

Sylvia hippolais, *Lath.* Ind., *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.
Bec-fin pouillot, *Temm.* Man. d'Ornith.
Lesser Pettychaps, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Not so common as either of the preceding species in the northern counties; known in many places by the provincial names of "Chiff-chaff," "Chip-chop," and "Choice and Cheap," from the sound of its usual notes during the breeding season. The nest is lined with feathers. The legs are darker than those of the other species, being of a blackish brown colour.

Genus REGULUS. GOLD CREST.

54. REGULUS AURICAPILLUS. COMMON GOLD CREST.

Regulus auricapillus, *Selby's* Illus. Br. Orn.
Sylvia regulus, *Lath.* Ind. Orn.
Regulus cristatus, *Raii.*
Roitelet ordinaire, *Temm.* Man. d'Ornith.
Gold-crested Wren, *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, &c.

Common in all our plantations, particularly those abounding in larch and fir. In addition

to our indigenous birds, vast numbers annually arrive upon our coast in the autumn, at the period of their equatorial migration from the northern countries of Europe.

Genus TROGLODYTES. WREN.

55. TROGLODYTES EUROPÆUS. COMMON WREN.

Troglodytes Europæus, *Cuv.* Reg. Anim., *Selby's* Illus. Br. Orn.
Troglodytes vulgaris, *Flemm.* Br. Anim.
Wren, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, &c.
Common Wren, *Selby*, *Flemm.*

Subfam. Motacillina.

Genus MOTACILLA. WAGTAIL.

56. MOTACILLA ALBA. PIED WAGTAIL.

Motacilla alba, *Linn.*, *Lath.*, *&c.*
Bergeronnette grise, *Temm.* Man. d'Ornith.
White Wagtail, *Penn.* Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.
Pied Wagtail, *Selby's* Illus. Br. Orn.

57. MOTACILLA BOARULA. GREY WAGTAIL.

Motacilla Boarula, *Linn.*, *Gmel.*, *Lath.*, *&c.*
La Bergeronnette jaune, *Temm.* Man. d'Ornith.
Grey Wagtail, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

A few individuals of this and the preceding species remain with us the whole year.

58. MOTACILLA FLAVA. YELLOW WAGTAIL.

Motacilla flava, *Linn.*, *Lath.*, *&c.*
Bergeronnette printanière, *Temm.* Man. d'Ornith.
Budytes flava, *Cuv.* Reg. Anim., *Stephens.*
Yellow Wagtail, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

This species is very locally distributed. Upon the coast it is seldom met with, but in the interior, where the soil is dry and gravelly, and the surface undulated, it is common during the summer months. It is a migratory species. Cuvier and some other naturalists have separated this kind from the Genus Motacilla, making it the type of the Genus Budytes. The only differential character consists in the greater length and straitness of the hinder claw, in which particular it shews its closer affinity to the Genus Anthus.

Genus ANTHUS. PIPIT.

59. ANTHUS AQUATICUS. ROCK PIPIT.

Anthus aquaticus, *Bechst.*, *Selby*, *&c.*
Anthus petrosus, *Flemm.* Br. Anim.
Alauda obscura, *Gmel.*, *Lath.*
Pipit spioncelle, *Temm.* Man. d'Ornith.
Rock or Shore Pipit, *Selby's* Illus. Br. Orn.
Rock Lark, *Mont.* Ornith. Dict.
Sea Titling, *Flemm.* Br. Anim.

A common species upon our rocky sea shores.

60. ANTHUS PRATENSIS. MEADOW PIPIT.

Anthus pratensis, *Bechst.*, *Selby*, *Flemm.*
Alauda pratensis, *Lath.*, *Gmel.*, *Raii.*
Alauda campestris, *Lath.* Ind. Orn.
Pipit farlouse, *Temm.* Man. d'Ornith.
Tit-Lark, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. and App. to Sup., *Bewick's* Br. Birds.
Pipit Lark, *Mont.* Ornith. Dict.
Meadow Pipit, *Selby's* Illus. Br. Orn.
Meadow Titling, *Flemm.* Br. Anim.

Very numerous and common upon our heaths and moors. The nest of this species is very frequently selected by the Cuckoo wherein to deposit her eggs.

61. ANTHUS ARBOREUS. TREE PIPIT.

Anthus arboreus, *Bechst.*, *Selby.*
Anthus trivialis, *Flemm.* Br. Anim.
Alauda trivialis, *Linn.*, *Lath.*
——— minor, *Lath.*
Pipit des buissons, *Temm.* Man. d'Ornith.
Field Lark, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.
Grasshopper Lark, *Bewick's* Br. Birds.
Tree Pipit, *Selby's* Illus. Br. Orn.
Field Titling, *Flemm.* Br. Anim.

This is a migratory species; appears early in May, and inhabits the borders of woods and plantations.

Subfam. Saxicolina.

Genus SAXICOLA. CHAT.

62. SAXICOLA ŒNANTHE. WHEAT-EAR CHAT.

Saxicola œnanthe, *Bechst.*, *Selby*, *Flemm.*
Sylvia œnanthe, *Lath.* Ind. Orn.
Motacilla œnanthe, *Linn.*, *Raii.*
Traquet moteux, *Temm.* Man. d' Ornith.
Wheat-ear, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.
Fallow Chat, *Flemm.* Br. Anim.

A migratory species; makes its first appearance about the 20th of March.

63. SAXICOLA RUBETRA. WHIN CHAT.

Saxicola rubetra, *Bechst.*, *Flemm.*, *Selby.*
Sylvia rubetra, *Lath.* Ind. Orn.
Traquet tarier, *Temm.* Man. d'Ornith.
Whin Chat, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

64. SAXICOLA RUBICOLA. STONE CHAT.

Saxicola rubicola, *Bechst.*, *Flemm.*, *Selby.*
Sylvia rubicola, *Lath.*
Traquet pâtre, *Temm.* Man. d'Ornith.
Stone Chat, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Family Pipridæ.

Genus PARUS. TITMOUSE.

65. PARUS MAJOR. GREAT TITMOUSE.

Parus major, *Linn.*, *Gmel.*, *Lath.*, *Raii*, *&c.*
Mésange charbonnière, *Temm.* Man. d'Ornith.
Great Titmouse, or Ox-eye, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

66. PARUS CŒRULEUS. BLUE TITMOUSE.

Parus cœruleus, *Linn.*, *Gmel.*, *Lath.*, *Briss*, *&c.*
Mésange bleue, *Temm.* Man. d'Ornith.
Blue Titmouse, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

67. PARUS ATER. COLE TITMOUSE.

Parus ater, *Linn.*, *Lath.*, *Raii*, *&c.*
Mésange petite charbonnière, *Temm.* Man. d'Ornith.
Cole-Mouse, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.
Cole Titmouse, *Selby's* Illus. Br. Orn.

The Cole Titmouse is now a very common bird in Northumberland, which I attribute to the extensive plantations, particularly of the fir tribe, which have been made within the last twenty or thirty years. In the natural pine forests of Scotland it is very abundant.

68. PARUS PALUSTRIS. MARSH TITMOUSE.

Parus palustris, *Linn.*, *Gmel.*, *Lath.*, *Raii.*
Mésange nonnette, *Temm.* Man. d'Ornith.
Marsh Titmouse, or Black-Cap, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

69. PARUS CAUDATUS. LONG-TAILED TITMOUSE.

Parus caudatus, *Linn.*, *Gmel.*, *Lath.*, *Raii.*
Mésange à longue queue, *Temm.* Man. d'Ornith.
Long-tailed Titmouse, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Genus BOMBYCILLA. WAX-WING.

70. BOMBYCILLA GARRULA. BOHEMIAN WAX-WING.

Bombycilla Bohemica, *Briss.*
Bombycivora garrula, *Temm.* Man. d'Ornith.
Ampelis garrulus, *Linn.*, *Lath.*
Grand-Jaseur, *Temm.*
Bohemian Chatterer, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

A very irregular visitant, sometimes several years intervening between the periods of their re-appearance. This also seems to be the case in America, as noticed by M. Chas. Bonaparte, Prince of Musignano, in his Continuation of Wilson's American Ornithology. The native country of this bird remains yet undiscovered, though it is probable it will be found in Central Asia.

Tribus III. Conirostres.

Family Fringillidæ.

Subfam. Alaudina.

Genus EMBERIZA. BUNTING.

71. EMBERIZA MILIARIA. COMMON BUNTING.

Emberiza miliaria, *Linn.*, *Lath.*, *&c.*
Bruant proyer, *Temm.* Man. d'Ornith.
Bunting, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

72. EMBERIZA CITRINELLA. YELLOW BUNTING.

Emberiza citrinella, *Linn.*, *Lath.*, *Raii*, *&c.*
Bruant jaune, *Temm.*
Yellow Bunting, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

73. EMBERIZA SCHŒNICULUS. REED BUNTING.

Emberiza schœniculus, *Linn.*, *Lath.*, *&c.*
Passer torquatus, *Raii.*
Bruant de Roseau, *Temm.*
Reed Bunting, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Genus PLECTROPHANES.

74. PLECTROPHANES NIVALIS.

Plectrophanes nivalis, *Selby.*
Emberiza nivalis, *Flemm.* Br. Anim.
Bruant de neige, *Temm.*

Adult Male.
- Emberiza nivalis, *Linn.*, *Lath.*
- Snow Bunting, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

Old Female in Winter Plumage.
- Emberiza glacialis, *Lath.*
- Emberiza mustelina.
- Tawny Bunting, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict.

Young of the Year.
- Emberiza montana, *Gmel.*, *Lath.*
- Lesser Mountain Finch and Bramlin, *Will.* (Angl.)
- Mountain Bunting, *Lath.* Syn., *Mont.* Ornith. Dict., *Shaw's* Zool.
- Tawny Bunting, *Bewick's* Br. Birds.

This genus has very judiciously been separated from the true Buntings, and comprises a few species well marked and easily recognised. A second species, the Plectrophanes Lapponica, has been killed in England. It is described in the 15th volume of the *Transactions of the Linnæan Society.* They form a beautiful connecting link between the Buntings and Larks.

Genus ALAUDA. LARK.

75. ALAUDA ARVENSIS. SKY-LARK.

Alauda arvensis, *Linn.*, *Gmel.*, *Lath.*
Alauda vulgaris, *Raii*, *Will.*

Alouette des champs, *Temm.* Man. d'Ornith.
Sky-Lark, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

76. ALAUDA ARBOREA. WOOD-LARK.

Alauda arborea, *Linn.*, *Gmel.*, *Lath.*, *Raii*, *&c.*
Alauda cristatella, *Lath.* Ind. Orn.
Alouette lulu, *Temm.* Man. d'Ornith.
Wood Lark, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

This is a very rare species in the northern parts of England. I have in my collection a very fine specimen, killed near Twizell, on the 24th November, 1827.

Subfam. Carduelina.

Genus CARDUELIS.

77, CARDUELIS ELEGANS. COMMON GOLDFINCH.

Fringilla carduelis, *Linn.*, *Gmel.*, *Lath.*
Gros-bec chardonneret, *Temm.* Man. d'Ornith.
Goldfinch, Br. Zool.. Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

78. CARDUELIS SPINUS. SISKIN.

Fringilla spinus, *Linn.*, *Lath.*
Gros-bec tarin, *Temm.* Man. d'Ornith.
Siskin or Aberdevine, Br. Zool., Arct. Zool., *Lath.*, Syn., *Mont.* Ornith. Dict. and Sup., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

The Siskin visits us during the winter, and is more or less abundant every year. They resort to the banks of rivulets, where alder and birch trees abound, and feed upon their seed. In the month of June, 1829, Sir William Jardine and myself met with Siskins in the Highlands of Scotland. They were in a large wood of ancient pines near to Killin, and in pairs; and I have no doubt had their nests in the summits of the firs, in which trees, according to Temminck, they are reported to breed.

Subfam. Passerina.

Genus FRINGILLA. FINCH.

79. FRINGILLA CŒLEBS. CHAFFINCH.

Fringilla cœlebs, *Linn.*, *Gmel.*, *Lath.*, *Raii*, *Briss.*
Gros-bec pinson, *Temm.* Man. d'Ornith.
Chaffinch, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

80, FRINGILLA MONTIFRINGILLA. MOUNTAIN FINCH.

Fringilla montifringilla, *Linn.*, *Lath.*, *Raii.*
Gros-bec d'Ardennes, *Temm.* Man. d'Ornith.
Brambling or Mountain Finch, Br. Zool., Arct. Zool., *Lath.* Syn , *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

A winter periodical visitant, and frequently very abundant. Feeds greatly upon beech mast.

Genus PASSER. SPARROW.

81. PASSER DOMESTICUS. HOUSE SPARROW.

Passer domesticus, *Raii.*
Fringilla domestica, *Linn.*, *Gmel.*, *Lath*, *&c.*
Grosbec moineau, *Temm.* Man. d'Ornith.
House Sparrow, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

82. PASSER MONTANUS. TREE SPARROW.

Passer montanus, *Raii.*
Fringilla montana, *Linn.*, *Gmel.*, *Lath.*
Gros-bec friquet, *Temm.*
Tree or Mountain Sparrow, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

This species is frequently met with in the neighbourhood of Durham and Bishop Auckland. A specimen in Mr. Hancock's collection was killed at the Rabbit Banks, near Newcastle. I have not been able to trace it farther north.

Genus LINARIA. LINNET.

83. LINARIA CANNABINA. COMMON OR BROWN LINNET.

Fringilla cannabina, *Linn.*, *Lath.*
Fringilla Linota, *Gmel.*, *Lath.*
Linaria rubra major, *Raii.*, *Will.* The adult in Summer plumage.
Gros-bec Linotte, *Temm.* Man. d'Ornith.
Common Linnet, Br. Zool., *Lath.* Syn., *Selby's* Illus. Br. Orn.
Greater Red-pole or Brown Linnet, *Mont.* Ornith. Dict.
Grey Linnet, *Bewick's* Br. Birds.
Greater Redpole or Red-headed Linnet, Br. Zool., *Lath.* Syn., *Bewick's* Br. Birds, Id. Sup.

A common species, and formerly considered, under the various states of plumage it assumes, as forming two distinct species.

84. LINARIA MONTIUM. MOUNTAIN LINNET OR TWITE.

Linaria montium, Mountain Linnet or Twite, *Selby.*
Fringilla montium, *Linn.*, *Lath.*
Linaria montana, *Raii*, *Briss.*
Gros-bec à gorge rousse ou de montagne, *Temm.* Man. d'Ornith.
Mountain Linnet, Br. Zool., *Lath.* Syn , *Mont.* Ornith. Dict , *Low's* Faun. Orcad., *Bewick's* Sup. to Br. Birds, *Flemm.* Br. Anim., *Selby's*, Illus. Br. Orn.
Twite, *Mont.* Ornith. Dict., *Shaw's* Zool.

Not so plentiful as the common Linnet, and affects the more elevated districts during summer. It is easily recognised by its notes.

85. LINARIA FLAVIROSTRIS. LESSER REDPOLE LINNET.

Fringilla linaria, *Linn.*, *Gmel.*, *Lath.*
Fringilla flavirostris, *Linn.*, *Lath.* Syn. of Young.
Gros-bec Sizerin, *Temm.* Man. d'Ornith.
Lesser Red-headed Linnet or Redpole, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

Lesser Redpole Finch, *Selby's* Illus. Br. Orn.
Rose Linnet, *Flemm.* Br. Anim.

A very common species in the northern counties.

86. LINARIA BOREALIS? NORTHERN REDPOLE LINNET?

In the *Illustrations of British Ornithology*, I have given a figure of a supposed large variety of Linaria flavirostris, from a specimen in the collection of Sir William Jardine. The difference in size, and the disposition of the colours in this bird, induced Sir William and myself to enter into a further investigation of this supposed variety; and after the examination of other individuals, we think it is entitled to rank as a distinct species.

Subfam. Pyrrhulina.

Genus PYRRHULA. BULL-FINCH.

87. PYRRHULA VULGARIS. COMMON BULL-FINCH.

Pyrrhula vulgaris, *Temm.* Man. d'Ornith., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.
Loxia Pyrrhula, *Linn.*, *Lath.*, *Raii.*
Bovreuil commun, *Temm.*
Bull-finch, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

Fam. Sturnidæ.

Subfam. Sturnina.

Genus STURNUS. STARLING.

88, STURNUS VULGARIS. COMMON STARLING.

Sturnus vulgaris, *Linn.*, *Lath.*, *Raii*, *Briss.*
Etourneau vulgaire, *Temm.*
Starling, *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.
Brown Starling or Solitary Thrush, *Bewick's* Sup. A young starling.

Genus PASTOR.

89. PASTOR ROSEUS. ROSE-COLOURED PASTOR.

Pastor roseus, *Temm.* Man. d'Ornith., *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.
Turdus roseus, *Linn.*, *Lath.*
Merula rosea, *Raii.*
Martin roselin, *Temm.*
Rose-coloured Pastor, *Selby's* Illus. Br. Orn.
Rose-coloured Ouzel or Thrush, Br. Zool. Appx., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

A very rare and occasional visitant. In my collection is a very fine male, killed out of a flock of Starlings upon the sea coast near Bamborough, in the month of July, 1818. Another male was taken about the same time, in a tan-pit yard near Newcastle; and Thomas Ellison, of that town, animal preserver, has an immature male, which was killed at Jesmond, in the spring of 1824, or 1825. Another was shot last year near Durham, and is now in the possession of Mr. Hutchinson, of that city.

Family Corvidæ.

Subfam. Corvina.

Genus PICA. PIE.

90. PICA COMMUNIS. MAGPIE.

Corvus pica, *Linn.*, *Gmel.*, *Lath.*, *Raii*, *&c.*
Pie, *Temm.*
Magpie, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Genus GARRULUS. JAY.

91. GARRULUS GLANDARIUS, COMMON JAY.

Corvus glandarius, *Linn.*, *Lath.*, *Raii.*
Garrulus, *Briss.*
Geai, *Temm.* Man. d'Ornith.
Jay, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

Genus CORVUS. CROW.

92. CORVUS CORAX. RAVEN.

Corvus corax, *Linn.*, *Lath.*
Corbeau noir, *Temm.* Man. d'Ornith.
Raven, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

93. CORVUS CORONE. CARRION CROW.

Corvus corone, *Linn.*, *Lath.*
Cornix, *Raii.*
Corneille noir, *Temm.* Man. d'Ornith.
Carrion Crow, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

94. CORVUS CORNIX. HOODED CROW.

Corvus cornix, *Linn.*, *Lath.*, &c.
Corvus cinerea, *Briss.*, *Raii.*
Corneille mantelée, *Temm.* Man. d'Ornith.
Royston Crow, *Will.* Albin., *Low's* Faun. Orcad.
Hooded Crow, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

This species is migratory with us, although in the north of Scotland it is indigenous and permanently resident.

95. CORVUS FRUGILEGUS. ROOK.

Corvus frugilegus, *Linn.*, *Lath.*
Cornix frugilega, *Briss.*
Freux, *Temm.*
Rook, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

96. CORVUS MONEDULA. JACKDAW.

Corvus monedula, *Linn. Lath., Raii, Briss.*
Choucas, *Temm.* Man. d'Ornith.
Jackdaw, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Subfam. Coracina.

Genus CORACIAS. ROLLER.

97. CORACIAS GARRULA. GARRULOUS ROLLER.

Coracias garrula, *Linn., Lath.*
Pica marina, *Raii.*
Rollier vulgaire, *Temm.*
Roller, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.
Garrulous Roller, *Selby's* Illus. Br. Orn.

A male specimen of this rare visitant was found dead, about eight years ago, in a plantation near Howick, the seat of Earl Grey; and I am informed that the late Mr. Bewick saw the wings of an individual that had been shot at Beaufront, upon the river Tyne. A fine specimen, now in the possession of Edw. Backhouse, jun. Esq., of Sunderland, was shot lately near South Shields. I may be allowed to mention here, that the *Fregilus graculus* (Cornish Chough), typical of the next Sub-family, inhabits the rocky coast of Berwickshire, about St. Abb's Head. A fine specimen was lately sent to me by Dr. G. Johnston, killed near Coldinghame; and another, deposited in the Society's museum, was killed at the same place.

Family Loxiadæ.

Genus LOXIA. CROSSBILL.

98. LOXIA CURVIROSTRA.

Loxia curvirostra, *Linn., Lath.*
Bec-croisé commun, ou des Pins, *Temm.* Man. d'Ornith.
Crossbill, or Sheld Apple, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.
Common Crossbill, *Selby's* Illus. Br. Orn.

This species visits the northern counties almost every year, in considerable flocks, resorting to plantations abounding with larch and other firs, as its food consists almost entirely of the seeds of the Abietinæ. I have not yet heard of the capture of the Loxia Pytiopsittacus (Parrot Crossbill), though it is probable it may occasionally visit us, in company with the Loxia curvirostra.

Genus STROBILOPHAGA. VIEIL.

99. STROBILOPHAGA ENUCLEATOR. PINE GROSBEAK.

Pyrrhula enucleator, *Temm.* Man. d'Ornith., *Selby's* Illus. Br. Orn.
Loxia enucleator, *Lnn., Lath.*
Corythus enucleator, *Cuvier* Reg. Anim.
Pine Grosbeak, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Shaw's* Zool., &c.

A specimen of this rare British species, now in the possession of Mr. Anthony Clapham, was shot at Bill Quay, near Newcastle.

Genus COCCOTHRAUSTES. GROSBEAK.

100. COCCOTHRAUSTES. COMMON GROSBEAK.

Fringilla coccothraustes, *Temm.* Man. d'Ornith.
Loxia coccothraustes, *Linn.*, *Lath.*, *Raii.*
Le Gros-bec, *Temm.* Man. d'Ornith.
Grosbeak or Hawfinch, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

An occasional visitant. A few years ago, I saw one at Alnwick Castle, which was killed at Huln Abbey. Two specimens were some time ago shot near Stockton upon Tees, one of which is now in the possession of Mr. R. R. Wingate. The Messrs. Hancock have another, which was killed at Streatlam, in the county of Durham.

101. COCOTHRAUSTES CHLORIS. GREEN GROSBEAK.

Coccothraustes chloris, *Flemm.* Br. Anim.
Fringilla chloris, *Temm.* Man. d'Ornith., *Selby's* Illus. Br. Orn.
Loxia chloris, *Linn. Lath.*, *Raii.*
Gros-bec verdier, *Temm.* Man. d'Ornith.
Greenfinch or Green-Grosbeak, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

Tribus Scansores.

Family Picidæ.

Genus PICUS. WOODPECKER.

102. PICUS VIRIDIS. GREEN WOODPECKER.

Picus viridis, *Linn.*, *Lath.*, *Raii.*
Pic vert, *Temm.* Man. d'Ornith.
Green Woodpecker, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

The Green Woodpecker is seldom seen in the northern parts of Northumberland. I have, however, met with it in the woods about Huln Abbey, near Alnwick, and upon the banks of the Wansbeck. It is common about Durham, and indeed in all localities where timber abounds, and has attained an advanced age.

103. PICUS MAJOR. GREAT SPOTTED WOODPECKER.

Picus major, *Linn. Lath.*
Picus varius major, *Raii*, *Briss.*
Pic Epeiche, *Temm.* Man. d'Ornith.
Great Spotted Woodpecker, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

I have met with this species in Northumberland, more frequently than the Green Woodpecker. Indeed, I am inclined to think, that they migrate from the more northern countries of Europe in Autumn, as I have obtained many specimens towards the fall of the year, some of which were killed near the coast, and in places where trees are far from abundant.

104. PICUS MINOR. LESSER SPOTTED WOODPECKER

Picus minor, *Linn.*, *Lath.*
Picus varius minor, *Briss.*

Pic épeichette, *Temm.* Man. d'Ornith.
Lesser Spotted Woodpecker, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

This is a very rare bird in the northern counties, though plentiful in Gloucestershire, and some other localities in the southern and midland parts of England. A specimen was some time ago killed at Wallsend.

Genus YUNX.

105. YUNX TORQUILLA. WRYNECK.

Yunx torquilla, *Linn.*, *Lath.*, *Raii*, *Briss.*
Torcol ordinaire, *Temm.* Man. d'Ornith.
Wryneck, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

The Wryneck is found in Northumberland, as far north as the woods upon the banks of the Wansbeck, but I have not been able to trace it beyond this line. About Durham it used to be pretty common, and I have frequently heard the peculiar and loud notes of three or four individuals at the same time, upon their first arrival in spring.

Family Certhiadæ.

Genus CERTHIA. CREEPER.

106. CERTHIA FAMILIARIS. COMMON CREEPER.

Certhia familiaris, *Linn.*, *Lath.*
Certhia, *Raii*, *Briss.*
Le Grimpereau, *Temm.* Man. d'Ornith.
Common Creeper, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Genus UPUPA. HOOPOE.

107. UPUPA EPOPS. COMMON HOOPOE.

Upupa epops, *Linn.*, *Lath.*, *Raii*, *Briss.*
La Huppe, *Temm.* Man. d'Ornith.
Hoopoe, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

A rare and occasional visitant. In my collection is a specimen which was taken alive near North Sunderland, about ten years ago. A short time since, another was shot near Morpeth; and a third is in the possession of a Mr. Bennet, killed at Gibside, in the county of Durham.

Genus SITTA. NUTHATCH.

108. SITTA EUROPEA. COMMON NUTHATCH.

Sitta Europea, *Linn.*, *Lath.*, *Raii.*
Sittelle torchepot, *Temm.* Man. d'Ornith.
Nuthatch, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

In the neighbourhood of Durham, I have frequently seen the Nuthatch, but I have been

unable to trace it in the northern parts of Northumberland. In the southern and midland counties it is very common.

Fam. Cuculidæ.

Genus CUCULUS. CUCKOO.

109. CUCULUS CANORUS. COMMON CUCKOO.

Cuculus canorus, *Linn.*, *Lath.*, *Briss.*
Coucou gris, *Temm.* Man. d'Ornith.
Common Cuckoo, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Upon our moors the Cuckoo is much more plentiful than in the lower and inclosed grounds. In the former situation, it generally selects the nest of the Anthus pratensis (Common Pipit) as the depository for its egg. Dr. Flemming, in his work on British Animals, seems to favour the idea, that the Cuckoo *sometimes constructs* its own nest, and incubates; and quotes a manuscript passage of Derham's, on instinct, communicated by Pennant to Barrington, as favouring this opinion; but from the statement there made, I have no doubt but that the supposed nest of the Cuckoo was that of a Night Jar, as it contained *two young ones*, which lived quietly together, and were *fed* by *the parent*,—a fact at variance with the observations hitherto made, which shew that the young Cuckoo instinctively endeavours to render itself sole master of the nest; and where two have happened to be hatched together, the struggle never ceased till one was forcibly ejected from the nest.

Order III. Rasores.

Fam. Columbidæ.

Genus COLUMBA. DOVE.

110. COLUMBA PALUMBUS. RING-DOVE.

Columba palumbus, *Linn.*, *Lath.*, *Briss.*
Palumbus torquatus, *Raii.*
Colombe ramier, *Temm.* Man. d'Ornith.
Ring Pigeon, Br. Zool., Arct. Zool., *Lath.* Syn.
Ring Dove, *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

111. COLUMBA TURTUR. TURTLE DOVE.

Columba turtur, *Linn.*, *Lath.*, *Raii.*
Colombe tourterelle, *Temm.* Man. d'Ornith.
Common Turtle, Br. Zool., *Lath.* Syn.
Turtle Dove, *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

This is a rare and occasional visitant in the north, although plentiful in many of the southern counties during the summer. In my collection is a male bird, killed near North Sunderland, in the autumn of 1818; and at this time, the gamekeeper of Ralph Carr, Esq. of Dunstan Hill, has a living specimen in his possession, having broken its wing with the gun. Bewick also mentions a flock which visited the meadows about Prestwick Car, and describes a young bird that was killed out of it.

Fam. Phasianidæ.

Genus PHASIANUS. PHEASANT.

112. PHASIANUS COLCHICUS. COMMON PHEASANT.

Phasianus colchicus, *Linn.*, *Briss.*, *Lath.*, *Raii.*
Faisan vulgaire, *Temm.* Man. d'Ornith.
Common Pheasant, *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

In Northumberland, the ring-necked variety is now the prevailing breed.

Fam. Tetraonidæ.

Genus COTURNIX. QUAIL.

113. COTURNIX VULGARIS. COMMON QUAIL.

Coturnix vulgaris, *Flemm.* Br. Anim.
Perdix coturnix, *Lath.*
Tetrao coturnix, *Linn.*, *Raii*, *Briss.*
La Caille, *Temm.* Man. d'Ornith.
Common Quail, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

The Quail is now a bird of rather rare occurrence in the northern counties, and few bevies are now seen, even upon grounds where formerly they used to be abundant. I am informed that it still breeds near Cleadon, in the county of Durham; and a nest with eggs was obtained by Mr. Geo. Wailes, from near Denton, last summer.

Genus PERDIX. PARTRIDGE.

114. PERDIX CINEREA. COMMON PARTRIDGE.

Perdix cinerea, *Raii*, *Lath.*, *Selby.*
Tetrao Perdix, *Linn.*
Perdrix grise, *Temm.* Man. d'Ornith.
Common Partridge, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Genus TETRAO.

115. TETRAO TETRIX. BLACK-COCK.

Tetrao tetrix, *Linn.*, *Lath.*
Urogallus minor, *Raii.*
Tétras birkhan, *Temm.* Man. d'Ornith.
Black Grous, Black Cock, or Black Game, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

Genus LAGOPUS. GROUS.

116. LAGOPUS SCOTICUS. RED-GROUS.

Lagopus Scoticus, *Flemm.* Br. Anim.
Tetrao Scoticus, *Lath.*
Tétras rouge, *Temm.* Man. d'Ornith.
Red-Grous, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

Grey and white varieties of this species have been killed in several parts of Northumberland and Durham, particularly at Blanchland, in the latter county.

Family Struthionidæ.

Genus OTIS. BUSTARD.

117. OTIS TETRAX. LITTLE BUSTARD.

Otis tetrax, *Linn.*, *Lath.*
Otis minor, *Raii*, *Briss.*
Outarde canepetière, *Temm.* Man. d'Ornith.
Little Bustard, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. and Sup., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn.

A very rare visitant; and the only instances of its capture in the northern counties, that I am aware of, are the two mentioned in the *Illustrations of British Ornithology*, Vol. I.

Order IV. Grallatores.

Fam. II. Ardeadæ.

Genus ARDEA. HERON.

118. ARDEA CINEREA. COMMON HERON.

Ardea cinerea, *Lath.*
Ardea major, *Linn.*, *Gmel.*, *Raii.*
Ardea cristata, *Briss.*
Héron cendré, *Temm.* Man. d'Ornith.
Common Heron, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm.* Br. Anim.

Genus BOTAURUS. BITTERN.

119. BOTAURUS STELLARIS. COMMON BITTERN.

Ardea stellaris, *Linn.*, *Lath.*, *Raii*, *Flemm.*
Botaurus, *Briss.*
Héron grand Butor, *Temm.* Man. d'Ornith.
Bittern, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

The Bittern is now but rarely met with in the northern counties, although, before the drainage of our bogs and mosses, it used to be common and well known. In my collection are two which were shot at Newham Lough, and a third near Berwick upon Tweed.

Genus IBIS. IBIS.

120. IBIS FALCINELLUS. GLOSSY IBIS.

Ibis falcinellus, *Temm.* Man. d'Ornith.
Tantalus falcinellus, *Linn.*, *Lath.*
Tantalus igneus, *Lath.*
Tantalus viridis, *Lath.*
Ibis falcinelle, *Temm.*
Bay Ibis, *Lath.* Syn.
Glossy Ibis, *Lath.* Syn.
Green Ibis, *Lath.* Syn.

A specimen of this species in the young state, or *Tantalus viridis* of Lath., was killed a few years ago, upon the banks of the Coquet, near Rothbury, and is now in my collection.

Family III. Scolopacidæ.

Genus NUMENIUS. CURLEW.

121. NUMENIUS ARQUATA. COMMON CURLEW.

Numenius arquata, *Lath.*
Scolopax arquata, *Linn.*, *Gmel.*
Numenius, *Briss.*
Grand courlis cendrè, *Temm.* Man. d'Ornith.
Common Curlew, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

122. NUMENIUS PHÆOPUS. WHIMBREL.

Numenius phæopus, *Lath.*, *Flemm.*
Scolopax phæopus, *Linn.*
Courlis corlieu, *Temm.* Man. d'Ornith.
Arquata minor, *Raii.*
Whimbrel, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

During the early spring months, Whimbrels are not uncommon upon our coast. They seem to retire to higher latitudes to breed, and I have hitherto been unable to detect them upon the moors or highlands of Scotland, during the breeding season.

Genus TOTANUS. SANDPIPER.

123. TOTANUS CALIDRIS. REDSHANK SANDPIPER.

Totanus calidris, *Bechst.*, *Temm.*, *Selby.*
Scolopax calidris, *Lath.*
Tringa Gambetta, *Lath.*
Chevalier Gambette, *Temm.* Man. d'Ornith.
Redshank, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm.* Br. Anim.

This is a common species upon our coast during winter. In summer, the plumage differs greatly from the winter livery, and it has, in consequence, been considered a distinct species. It would appear, that the *Totanus Bewickii* of Stephens (*Shaw's Zool.*, vol. xii. p. 138), is a Redshank in the nuptial dress.

124. TOTANUS FUSCUS.

Totanus fuscus, *Temm.* Man. d'Ornith.
Scolopax fusca, *Linn.*
Scolopax totanus, *Linn.*
Godwit, and Dusky Sandpiper,
Scolopax curonica et Cantabrigiensis, *Lath.*, *Gmel.*
Spotted Redshank, Dusky Snipe, Cambridge Godwit.

A young specimen, killed at Jarrow Slake, is now in the collection of the Society.

125. TOTANUS OCHROPUS. GREEN SANDPIPER.

Totanus ochropus, *Temm.*, *Selby*, *Flemm.*
Tringa ochropus, *Linn.*, *Lath.*
Chevalier cul-blanc, *Temm.*
Green Sandpiper, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Shaw's* Zool., *Selby's* Illus. Br. Orn.
Wood Sandpiper, Linn. Trans. i. 130.

A rare species. In my collection are two fine specimens, killed near to Twizell, one in the autumn of 1820, the other in 1824. A specimen in the Museum of the Society, was shot near Close House, in May, 1829; another, also in the Museum, was shot in October, 1830, near Hilton Castle, in the county of Durham, by T. V. R. Dutton, Esq.

126. TOTANUS GLAREOLA. WOOD SANDPIPER.

Totanus glareola, *Temm.*, *Flemm.*, *Selby.*
Tringa glareola, *Linn.*, *Lath.*, *Mont.*
Tringa grallatoris, *Mont.* App. to Sup. Ornith. Dict.
Chevalier Sylvain, *Temm.* Man. d'Ornith.
Wood Sandpiper, *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm.* Br. Anim.

A beautiful specimen of this rare and interesting species was shot in the autumn of 1828, at Ellingham, and is now in my collection. A second killed at Prestwick Car, in 1830, is now deposited in the Museum of the Society, and a third is in the possession of Mr. Ed. Backhouse, shot at White Mare Pool, in the county of Durham.

127. TOTANUS HYPOLEUCOS. COMMON SANDPIPER.

Totanus hypoleucos, *Temm.*, *Flemm.*, *Selby.*
Tringa hypoleucos, *Linn.*, *Lath.*
Chevalier guignette, *Temm.* Man. d'Ornith.
Common Sandpiper, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

Genus RECURVIROSTRA. AVOCET.

128. RECURVIROSTRA AVOCETTA. SCOOPING AVOCET.

Recurvirostra avocetta, *Linn.*, *Lath.*, *Raii*, *&c.*
Avocette à nuque noire, *Temm.* Man. d'Ornith.
Scooping Avocet, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

A rare bird in the north of England. A specimen was killed not long ago at Hartley, and is now in the possession of Mr. Wardle.

Genus LIMOSA. GODWIT.

129. LIMOSA RUFA. COMMON OR BARTAILED GODWIT.

Limosa rufa, *Briss.*, *Flemm.*, *Selby.*
Barge rousse, *Temm.* Man. d'Ornith.

Summer Plumage.
- Scolopax Lapponica, *Linn.*, *Lath.*, *&c.*
- Red Godwit, Br. Zool., *Lath.* Syn.
- Scolopax noveboracensis, *Lath.*, *Mont.*
- Red-breasted Snipe, *Mont.* Sup. to Ornith. Dict.

Winter Plumage.
- Scolopax leucophæa, *Lath.* Ind. Ornith.
- Common Godwit, Br. Zool., *Lath.* Syn. and Sup., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

130. LIMOSA MELANURA. BLACK-TAILED GODWIT.

Limosa melanura, *Leisler*, *Temm.*, *Selby.*
Fedoa melanura, *Steph.*
Barge à queue noire, *Temm.* Man. d'Ornith.
Black-tailed Godwit, *Shaw's* Zool., *Flemm.* Br. Anim.

A rare species in the northern counties. Two specimens, killed at Budle Bay, were brought to me in April, 1831, in all probability on their way to higher latitudes to breed. They were in moult, and rapidly acquiring the nuptial livery.

Genus SCOLOPAX.

131. SCOLOPAX RUSTICOLA. WOODCOCK.

Scolopax rusticola, *Linn.*, *Lath.*, *Flemm.*, *&c.*
Bécasse ordinaire, *Temm.* Man. d'Ornith.
Woodcock, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds., *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

The Woodcock has been known to breed in Northumberland, and I have an egg taken from a nest near Mitford. A young Woodcock, now in the Museum, was caught near Allenheads.

132. SCOLOPAX MAJOR. SOLITARY SNIPE.

Scolopax major, *Lath.*, *Flemm.*, *&c.*
Grande ou double Bécassine, *Temm.* Man. d'Ornith.
Great Snipe, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

A rare and occasional visitant. In my collection is a fine specimen killed in a bog, near Twizell. Several were shot during the dry autumn of 1826, in a marsh near Sedgefield, in the county of Durham; and a fine specimen was presented to the Society by Colonel Shadforth, of Witton-le-Wear, killed near to that place in the month of October, 1830.

133. SCOLOPAX GALLINAGO. COMMON SNIPE.

Scolopax gallinago, *Linn.*, *Lath.*, *Flemm.*, *&c.*
Bécassine ordinaire, *Temm.* Man. d'Ornith.
Snipe or Snite, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

134. SCOLOPAX GALLINULA. JACK SNIPE.

Scolopax gallinula, *Linn.*, *Lath.*, *Flemm.*, *&c.*
Gallinago minima, *Raii.*
Bécassine sourde, *Temm.* Man. d'Ornith.
Jack-Snipe, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

Genus MACHETES. RUFF.

135. MACHETES PUGNAX. RUFF.

Machetes pugnax, *Cuv.* Reg. Anim., *Shaw's* Zool.
Tringa pugnax, *Temm.* Man. d'Ornith.
Summer Plumage of both Sexes. { Tringa pugnax, *Linn.*, *Lath.*, *Briss.* / Ruff or Reeve, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict.
Tringa littorea, *Lath.*
Shore Sandpiper, *Lath.* Syn.
Tringa equestris et grenovicensis, *Lath.* Ind. Orn.
Greenwich Sandpiper, *Lath.* Ind. Orn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

This species breeds annually at Prestwick Car. I have also killed several young birds and adults (in winter plumage) upon the shore near Budle and the slake or ooze interposed between the mainland and Holy Island, about the latter end of September or beginning of October. Several were also killed out of a flock this autumn, near Rock; and in August, 1827, I received a female from Ellingham.

Genus TRINGA.

136. TRINGA VARIABILIS. DUNLIN.

Tringa variabilis, *Meyer*, *Temm.*
Tringa alpina, *Flemm.* Br. Anim.
Dunlin, *Flemm.*, *Selby's* Illus. Br. Orn.
Winter Plumage. { Tringa cinclus, *Linn.*, *Lath.*
Purre or Stint, Br. Zool., *Lath.* Syn.
Tringa Alpina, *Linn.*, *Lath.*
Summer Plumage. { Cinclus torquatus, *Briss.*
Dunlin, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

137. TRINGA SUBARQUATA. PIGMY CURLEW.

Tringa subarquata, *Temm.* Man. d'Ornith., *Shaw's* Zool., *Flemm.* Br. Anim., *&c.*
Scolopax Africana, *Lath.* Ind. Orn., *Gmel.* Syst.
Cape Curlew, *Lath.* Syn.
Pigmy Curlew, *Mont.* Orn. Dict. and Sup.
Red Sandpiper, *Penn.* Arct. Zool., *Lath.* Syn.
Red Dunlin, *Shaw's* Zool.

A rare British species. A male and female now in the possession of Mr. Ed. Backhouse, jun. were killed near Hartlepool, in the county of Durham.

138. TRINGA MARITIMA. PURPLE OR ROCK TRINGA.

Tringa maritima, *Brunn.*, *Selby.*
Tringa nigricans, *Mont.*, Trans. Linn. Soc.
Bécasseau violet, *Temm.* Man. d'Ornith.
Selninger Sandpiper, *Lath.* Syn.
Purple Sandpiper, *Mont.* Ornith. Dict.
Knot, *Bewick's* Br. Birds.

Common upon all our rocky shores. A winter visitant.

Genus PHALAROPUS. PHALAROPE.

139. PHALAROPUS LOBATUS. GREY PHALAROPE.

Phalaropus lobatus, *Lath.*, *Flemm.*, *Selby.*
Phalaropus platyrynchus, *Temm.* Man. d'Ornith.
Tringa lobata, *Linn.*
Grey Phalarope, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

This is a rare and occasional visitant. In my collection is one, killed near Embleton, about eight years ago; and another, greatly injured, was since sent to me by the keeper of the further light-house upon the Fern Islands. A very fine specimen, now in the Museum of the Society, was lately shot by the edge of a pool, near Heddon-on-the-Wall.

Genus LOBIPES. COOTFOOT.

140. LOBIPES HYPERBOREUS. RED-NECKED COOTFOOT.

Lobipes hyperboreus, *Flemm.*, *Stephens*, *Selby*.
Phalaropus hyperboreus, *Lath.* Ind. Orn., *Temm.* Man. d'Ornith., *Sabine* in Linn. Trans.
Tringa hyperborea, *Linn.*
Red Phalarope, Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.
Red Cootfoot, *Flemm.* Br. Anim.
Red Lobefoot, *Stephens*, *Shaw's* Zool.

The red Cootfoot is also a very rare visitant. The only specimen I have met with was one killed upon the coast, near to Alnmouth, in the spring of 1828.

Family IV. Rallidæ.

Genus RALLUS. RAIL.

141. RALLUS AQUATICUS. WATER RAIL.

Rallus aquaticus, *Linn.*, *Lath.*, *Flemm.*, *&c.*
Rale d'Eau, *Temm.* Man. d'Ornith.
Water Rail, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Genus ORTYGOMETRA. CRAKE.

142. ORTYGOMETRA CREX. LAND, OR CORN-CRAKE.

Ortygometra crex, *Steph.*, *Flemm.*
Gallinula crex, *Lath.* Ind. Orn.
Rallus crex, *Linn.*
Poule-d'eau de genet, *Temm.* Man. d'Ornith.
Crake Gallinule, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict.
Corn Crake, *Steph.*, *Flemm.*, *&c.*

143. ORTYGOMETRA PORZANA. SPOTTED CRAKE.

Ortygometra Porzana, *Steph.*
Gallinula Porzana, *Lath.*, *Flemm.*
Rallus Porzana, *Linn.*
Poule-d'eau maronette, *Temm.* Man. d'Ornith.
Spotted Gallinule, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm.* Br. Anim.
Water Crake, *Bewick's* Br. Birds.
Spotted Crake, *Shaw's* Zool.

A summer visitant, not numerous, and confined to the sedgy margins of ponds and marshes. I obtained specimens this season from Newham Lough, and I have also had it from the nighbourhood of Mitford.

Genus GALLINULA. GALLINULE.

144. GALLINULA CHLOROPUS. COMMON GALLINULE.

Gallinula chloropus, *Lath.* Ind. Orn., *Flemm.* Br. Anim., *Stephens.*
Poule-d'eau ordinaire, *Temm.* Man. d'Ornith.
Common Gallinule, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *Shaw's* Zool., *Selby's* Illus. Br. Orn.

Genus FULICA. COOT.

145. FULICA ATRA. COMMON COOT.

Fulica atra, *Linn.*, *Raii*, *Briss.*, *Lath.*, *&c.*
Fulica major, *Briss.*, *Raii.*
Common Coot, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *Shaw's* Zool., *Selby's* Illus. Br. Orn.

Family V. Charadriadæ.

Genus HÆMATOPUS. OYSTER-CATCHER.

146. HÆMATOPUS OSTRALEGUS. PIED OYSTER-CATCHER.

Hæmatopus Ostralegus, *Linn.*, *Lath.*, *Flemm.*, *&c.*
Huiterier Pie, *Temm.* Man. d'Ornith.
Sea-Pie, or Pied Oyster-Catcher, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. and Sup., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

Genus STREPSILAS. TURNSTONE.

147. STREPSILAS INTERPRES. COMMON TURNSTONE.

Strepsilas interpres, *Leach*, *Shaw's* Zool., *Flemm.* Br. Anim.
Strepsilas collaris, *Temm.* Man. d'Ornith.
Tringa interpres, *Linn.*, *Lath.*
Tringa morinella, *Linn.* (Young.)
Turnstone, or Sea Dottrell, *Lath.* Syn., Id. Sup., *Mont.* Ornith. Dict., *Shaw's* Zool.
Hebridal Sandpiper, Br. Zool.

Common during the winter upon the rocky coast near Bamburgh; but I have observed that in a flock of upwards of one hundred, seldom more than three or four were in the matured plumage. I am informed that several in the summer plumage were shot near Tynemouth during the summers of 1829 and 1830.

Genus VANELLUS. LAPWING.

148. VANELLUS CRISTATUS. COMMON LAPWING.

Vanellus cristatus, *Meyer*, *Flemm.*, *Selby*, *&c.*
Tringa vanellus, *Linn.*, *Lath.*, *&c.*
Vanneau huppè, *Temm.* Man. d'Ornith.
Lapwing, or Bastard Plover, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

Genus SQUATAROLA. WHISTLER.

149. SQUATAROLA CINEREA. GREY WHISTLER.

Squatarola cinerea, *Flemm.* Br. Anim.
Squatarola grisea, *Steph.*, *Shaw's* Zool.
Tringa Squatarola et Helvetica, *Linn.*, *Lath.*
Vanellus melanogaster, *Temm.* Man. d'Ornith.
Grey Sandpiper, *Penn.* Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. et Sup.
Grey Plover, *Bewick's* Br. Birds.

A winter visitant, and not uncommon upon the slake or ooze which separates Holy Island from the mainland.

Genus ARENARIA. SANDERLING.

150. ARENARIA VULGARIS. COMMON SANDERLING.

Arenaria vulgaris, *Bechst.*, *Temm.*, *Steph.*
Calidris arenaria, *Leach*, *Flemm.*
Tringa arenaria, *Linn.*, *Lath.*
Charadrius calidris et rubidus, *Linn.*, *Gmel.*, *Lath.*
Ruddy Plover, Arct. Zool., *Lath.* Syn., *Wils.* Amer. Orn.
Sanderling or Curwillet, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *&c.*

Considerable flocks of Sanderlings are met with upon our coast during the period of their autumnal flight, but few remain with us during the winter. When they first appear the young have not lost their first feathers, and the old birds retain a considerable portion of that varied plumage which distinguishes them during the summer.

Genus CHARADRIUS. PLOVER.

151. CHARADRIUS PLUVIALIS. GOLDEN PLOVER.

Charadrius pluvialis, *Linn.*, *Lath.*, *Wils.*, *&c.*
Charadrius Africanus, *Gmel.*, *Lath.*
Pluvier doré, *Temm.* Man. d'Ornith.
Golden Plover, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.
Alwargrim Plover, *Penn.* Arct. Zool., *Lath.* Syn. (Summer Plumage.)

152. CHARADRIUS MORINELLUS. DOTTEREL.

Charadrius morinellus, *Linn.*, *Lath.*
Charadrius Asiaticus et Tartaricus, *Lath.*
Pluvier guignard, *Temm.* Man. d'Ornith.
Dotterel, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.
Asiatic Plover, *Lath.* Syn.

Flocks of Dotterels are annually met with in particular districts, during the month of May, at the time of their periodical polar migration. Scremerston, in North Durham, near Berwick, may be cited as one locality, where they always appear in considerable numbers. Their stay is seldom for more than a week or ten days.

153. CHARADRIUS HIATICULA. RING PLOVER.

Charadrius Hiaticula, *Linn.*, *Lath.*, *&c.*
Grand pluvier a collier, *Temm.* Man. d'Ornith.
Ringed Plover, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

Order V. Natatores.

Family I. Anatidæ.

Genus ANSER. GOOSE.

154. ANSER FERUS. GREY-LAG WILDGOOSE.

Anser ferus, *Steph.*, *Shaw's* Zool., *Selby's* Illus. Br. Orn.
Anser palustris, *Flemm.* Br. Anim.
Anas Anser, *Linn.*, *Lath.*
Oie cendrée, *Temm.* Man. d'Ornith.

Grey-Lag Goose, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *&c.*

The Grey Lag is by no means a common or numerous species in Britain, and is seldom seen in flocks of more than ten or twelve together. The specimens brought to me have generally been killed in the early spring months, at the time farmers commence sowing the fields with peas and beans, upon which they frequently alight to feed.

155. ANSER SEGETUM. BEAN GOOSE.

Anser segetum, *Temm.*, *Steph.*, *Selby.*
Anser ferus, *Flemm.* Br. Anim.
Anas segetum, *Lath.*
Bean Goose, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *&c.*
Wild-Goose, *Flemm.* Br. Anim.

A periodical winter visitant, very numerous, and in large flocks.

156. ANSER ERYTHROPUS. WHITE-FRONTED WILDGOOSE.

Anser erythropus, *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.
Anas erythropus, *Linn.*
Anas albifrons, *Lath.*, *Temm.* Man. d'Ornith.
Anser albifrons, *Steph.*, *Shaw's* Zool.
White-fronted Goose, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict.
Laughing Goose, *Flemm.* Br. Anim.

A winter visitant, but not so numerous as the preceding species.

Genus BERNICLA. BERNICLE.

157. BERNICLA LEUCOPSIS. COMMON BERNICLE.

Bernicla leucopsis, *Selby's* Illus. Br. Orn.
Bernicla erythropus, *Steph.*, *Shaw's* Zool.
Anas leucopsis, *Temm.* Man. d'Ornith.
Anas erythropus, *Lath.*
Bernicle or Clakis, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *&c.*

A winter visitant, and very numerous upon the western coast of Britain, but rare upon the eastern. I have received specimens from Holy Island.

158. BERNICLA BRENTA. BRENT BERNICLE.

Bernicla brenta, *Steph.*, *Selby*, *&c.*
Anas bernicla, *Linn.*, *Lath.*, *Temm.*, *Flemm.*
Brent or Brand Goose, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *&c.*

This species resorts to the eastern and southern shores during winter, in immense flocks.

Genus CYGNUS. SWAN.

159. CYGNUS FERUS. WILD SWAN, OR HOOPER.

Cygnus ferus, *Raii*, *Briss.*, *Stephens*, *Flemm.*, *Selby.*

Anas Cygnus ferus, *Linn.*, *Lath.*
Wild Swan, *Penn.* Br. Zool.
Whistling Swan, Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *&c.*

An occasional winter visitant.

160. CYGNUS BEWICKII. BEWICK'S SWAN.

Cygnus Bewickii, *Yarrell*, in Trans. Linn. Soc., *Selby*, in Trans. Nat. Hist. Soc. North. Dur. and Newcastle.

A recently discovered species, and first indicated as such by Mr. Richard Rutledge Wingate, of Newcastle. An occasional winter visitant.

Genus TADORNA. SHELDRAKE.

161. TADORNA VULPANSER. COMMON SHELDRAKE.

Tadorna Vulpanser, *Flemm.*, *Selby.*
Tadorna Bellonii, *Steph.*
Anas Tadorna, *Linn.*, *Lath.*, *&c.*
Sheldrake, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

Genus SPATHULEA. SHOVELLER.

162. SPATHULEA CLYPEATA. COMMON SHOVELLER.

Spathulea clypeata, *Flemm.*, *Selby.*
Rhynchapsis clypeata, *Steph.*
Anas clypeata, *Linn.*, *Lath.*, *&c.*
Shoveller, and Red-breasted Shoveller, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.
Common Shoveller, *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

Genus ANAS. DUCK.

163. ANAS ACUTA. PINTAIL DUCK.

Anas acuta, *Linn.*, *Lath.*, *Flemm.*
Dafila caudacuta, *Steph.*
Pintail, Br. and Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.
Cracker, *Flemm.* Br. Anim.

This is a rare species in the north. I have received specimens from Holy Island and Prestwick Car. It has also been killed near to North Shields.

164. ANAS BOSCHAS. COMMON WILD-DUCK.

Anas Boschas, *Linn.*, *Lath.*, *&c.*
Wild-duck or Mallard, Br. and Arct. Zool., Lath. Syn., *Bewick's* Br. Birds, *Mont.* Ornith. Dict., *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

165. ANAS PENELOPE. COMMON WIGEON.

Anas Penelope, *Linn.*, *Lath.*, *Flemm.*, *&c.*
Mareca fistulans, *Steph.*
Canard siffleur, *Temm.* Man. d'Ornith.

Wigeon, Whewer, Whim, Br. and Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm., &c.*

A periodical winter visitant, and very numerous upon all our coasts and inland lakes.

166. ANAS CRECCA. COMMON TEAL.

Anas Crecca, *Linn., Lath., &c.*
Querquedula Crecca, *Steph.*
Canard sarcelle d'hiver, *Temm.* Man. d'Ornith.
Common Teal, Br. Zool., Arct. Zool., *Lath.* Syn., *Steph*, *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

Genus MERGUS.

167. MERGUS MERGANSER. GOOSEANDER.

Mergus Merganser, *Linn., Lath., Wils., Flemm.*
Grand Harle, *Temm.* Man. d'Ornith.
Gooseander, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

Female. { Mergus Castor, *Linn., Lath.*
Dundiver or Sparling-fowl, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

In severe winters several individuals, both male and female, are killed in Northumberland. In March, 1830, two beautiful males and a female were killed in a small pond at Newlands, near Belford.

168. MERGUS SERRATOR. RED-BREASTED MERGANSER.

Mergus Serrator, *Linn.* Syst., *Lath.* Ind., *&c.*
Harle huppé, *Temm.* Man. d'Ornith.
Red-breasted Merganser, Br. Zool., *Lath.* Syn.. *Mont.* Ornith. Dict., *Bewick's* Br. Birds.
Red-breasted Gooseander, *Flemm.* Br. Birds.

This is met with more frequently in the estuaries of our rivers and bays than the preceding species. Several are annually brought to me from Budle Bay, Holy Island, and the adjacent coast.

169. MERGUS ALBELLUS. SMEW.

Mergus albellus, *Linn.* Syst., *Lath.*
Harle piette, *Temm.* Man. d'Ornith.
Smew or White Nun, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., Id. Sup., *Bewick's* Br. Birds.

Female and Young. { Mergus minutus, *Lath.*
Lough diver, Br. Zool., *Bewick's* Br. Birds.
Red-headed Smew, Br. Zool.

A winter visitant, but very rare in the adult state in the north of England. A fine specimen was killed near Sunderland last winter 1829 and 1830, now in the possession of E. Backhouse, Esq.

Genus CLANGULA. GARROT.

170. CLANGULA CHRYSOPTHALMOS. GOLDEN-EYE GARROT.

Clangula chrysopthalmos, *Steph., Shaw's* Zool., *Selby's* Illus. Br. Orn.

Anas Clangula, *Linn.*, *Lath.*, *&c.*
Canard garrot, *Temm.* Man. d'Ornith.
Golden-eye, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict.
Female and Young. { Anas Glaucion, *Lath.* Ind. / Morillon, *Briss.* / Glaucium or Morillon, Br. Zool., *Lath.* Syn.

A common, though not a numerous species, during winter.

Genus HARELDA. HARELD.

171. HARELDA GLACIALIS. LONG-TAILED HARELD.

Harelda glacialis, *Leach*, *Steph.*, *Shaw's* Zool.
Clangula glacialis, *Flemm.* Br. Anim.
Canard de miclon, *Temm.* Man. d'Ornith.
Anas glacialis, *Linn. Lath.*
Long-tailed Duck, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. Sup., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *&c.*

Common as a winter visitant upon the coast.

Genus FULIGULA. POCHARD.

172. FULIGULA FERINA. RED-HEADED POCHARD.

Fuligula ferina, *Steph.*
Nyroca ferina, *Flemm.*
Anas ferina, *Linn*, *Lath.*,
Anas rufa, *Lath.*
Canard Milouin, *Temm.* Man. d'Ornith.
Pochard or Red-headed Wigeon, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. and Sup., *Bewick's* Br. Birds, *Flemm.* Br. Anim.
Red-headed Pochard, *Steph.*, *Selby.*

Not numerous in the north, a common species in Norfolk and Lincolnshire.

173. FULIGULA LEUCOPTHALMOS. WHITE-EYED POCHARD.

Fuligula Nyroca, *Steph.*
Nyroca leucopthalmos, *Flemm.* Br. Anim.
Anas Nyroca, *Lath.* Ind.
Canard à Iris blanc ou Nyroca, *Temm.* Man. d'Ornith.
African Teal, *Lath.* Syn.,
Ferruginous Duck, *Mont.* Ornith. Dict.
White-eye, *Flemm.* Br. Anim.

A very rare species. The individual from which the figure in the *Illustrations of British Ornithology* was taken, was killed on the river Tyne, in the neighbourhood of Hexham.

174. FULIGULA CRISTATA. TUFTED POCHARD.

Fuligula cristata, *Steph.*, *Shaw's* Zool., *Selby's* Illus. Br. Orn.
Anas Fuligula, *Linn.*, *Lath.*, *Wils.*
Canard morillon, *Temm.* Man. d'Ornith.
Tufted Duck, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.
Young. { Anas scandiaca, *Lath.* Ind. Orn. / Lapmark Duck, *Lath.* Syn. / Brown Duck, *Penn.* Br. Zool.

175. FULIGULA MARILA. SCAUP POCHARD.

Fuligula Marila, *Steph.*, *Selby.*
Nyroca Marila, *Flemm.* Br. Anim.
Anas Marila, *Linn.*, *Lath.*
Canard milouinan, *Temm.* Man. d'Ornith.
Scaup Duck, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

A common periodical winter visitant. Inhabits bays, and estuaries of rivers.

Genus OIDEMIA. SCOTER.

176. OIDEMIA FUSCA. VELVET SCOTER.

Oidemia fusca, *Flemm.*, *Steph.*, *Selby.*
Velvet Scoter, *Flemm.*, *Steph.*, *Selby.*
Anas fusca, *Lath.* Ind. Orn.
Canard double macreuse, *Temm.* Man. d'Ornith.
Velvet Duck, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *&c.*

177. OIDEMIA NIGRA. BLACK SCOTER.

Oidemia nigra, *Steph.*, *Flemm.*, *Selby.*
Anas nigra, *Linn.*, *Lath.*
Canard macreuse, *Temm.* Man. d'Ornith.
Scoter, or Black Diver, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. and Sup., *Bewick's* Br Birds, *&c.*
Black Scoter, *Flemm.* Br. Anim., *Steph.*, *Shaw's* Zool., *Selby's* Illus. Br. Orn.

Both species of Scoters are inhabitants of the seas: they feed upon shell-fish, roe, &c. Not uncommon as winter visitants upon our coast.

Genus SOMATERIA. EIDER.

178. SOMATERIA MOLLISSIMA. COMMON EIDER.

Somateria mollissima, *Leach*, *Steph.*, *Selby.*
Anas mollissima, *Linn.*, *Lath.*
Anas Sancti Cuthberti, *Raii.*
Canard Eider, *Temm.* Man. d'Ornith.
Eider, or Cuthbert Duck, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *&c.*

Family II. Colymbidæ.

Genus PODICEPS. GREBE.

179. PODICEPS CRISTATUS. GREAT CRESTED GREBE.

Podiceps cristatus, *Lath.*, *Steph.*, *Flemm.*, *Selby.*
Colymbus cristatus, *Linn.*
Grêbe huppé, *Temm.* Man. d'Ornith.
Crested Grebe, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *&c.*
Young. { Colymbus urinator, *Linn.*
{ Tippet Grebe, Br. Zool., *Lath.* Syn.

Rare in the northern counties. All the specimens brought to me have been young birds.

180. PODICEPS RUBRICOLLIS. RED-NECKED GREBE.

Podiceps rubricollis, *Lath.*, *Flemm.*, *Steph.*, *Selby.*
Colymbus rubricollis, *Linn.*, *Gmel.*
Grebe jou-gris, *Temm.* Man. d'Ornith.
Red-necked Grebe, *Lath.* Syn. and Sup., *Mont.* Ornith. Dict., *Steph.*, *Shaw's* Zool., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

Very rare. I have received three specimens within the last four years, from the Fern Islands, killed in February; one in perfect plumage. Three or four in immature plumage were killed upon the Tyne during the winter of 1829–30.

181. PODICEPS AURITUS. EARED GREBE.

Podiceps auritus, *Lath.*, *Steph.*, *Flemm.*, *Selby*, *&c.*
Colymbus auritus, *Linn.*
Grebe oreillard, *Temm.* Man d'Ornith.
Eared Grebe, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm.* Br. Anim., *&c.*

The young of this species is sometimes killed upon the coasts, or estuaries of our rivers, but I have never met with it in the adult summer plumage. In the young state it resembles the P. cornutus so closely, both in size and colour, that the only character by which it can be distinguished is in the form and proportion of the bill. Both kinds are indiscriminately called Dusky Grebes.

182. PODICEPS CORNUTUS. SCLAVONIAN GREBE.

Podiceps cornutus, *Lath.*, *Flemm.*, *Steph.*, *Selby.*
Colymbus cornutus, *Gmel.*
Grebe cornu, ou Esclavon, *Temm.* Man. d'Ornith.
Podiceps obscurus, *Lath.*
Horned Grebe, Arct. Zool., *Lath.* Syn., *Flemm.* Br. Anim.
Sclavonian Grebe, *Mont.* Ornith. Dict., *Steph.*, *Shaw's* Zool.
Dusky Grebe, Br. Zool., *Lath.* Syn., *&c.*

The young of this species is not rare, but the only specimen of the adult that has come to my knowledge is that of a female in the possession of the Messrs. Hancock, which was killed at sea off Cullercoats in 1830.

183. PODICEPS MINOR. LITTLE GREBE.

Podiceps minor, *Steph.*, *Flemm*, *Selby*, *&c.*

Summer Plumage of Adults.
- Podiceps Hebridicus, *Lath.*
- Colymbus Hebridicus, *Gmel.*
- Black-chinned Grebe, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., Id. Sup., *Bewick's* Br. Birds.

Young.
- Podiceps minor, *Lath.*
- Colymbus minor, *Gmel.*

Genus COLYMBUS. DIVER.

184. COLYMBUS GLACIALIS. NORTHERN DIVER.

Colymbus glacialis, *Linn.*, *Lath.*, *Flemm.*, *Steph.*, *&c.*
Colymbus maximus caudatus, *Raii.*
Plongeon Imbrim, *Temm.* Man. d'Ornith.

Northern Diver, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *&c.*

Young. { Colymbus Immer, *Linn.* Syst., *Lath.*
Imber Diver, Br. Zool., Arct. Zool., *Lath.* Syn., *Bewick's* Br. Birds, *&c.*

The young of this species is frequently killed upon the coast, and I receive many specimens from Holy Island. The adults are not so common. Two fine birds were killed in 1824 on the river Tyne, one of which is now in the Museum of the Society: another matured specimen, also in the Museum, was shot near Embleton.

185. COLYMBUS ARCTICUS. BLACK-THROATED DIVER.

Colymbus arcticus, *Linn.*, *Lath.*, *Flemm.*, *Steph.*
Plongeon Lumme, ou à gorge noire, *Temm.* Man. d'Ornith.
Black-Throated Diver, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Steph.*, *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

A rare winter visitant. In 1828 two young birds were shot near Bywell, upon the Tyne. In 1830 I received a fine mature specimen from Berwick, which was killed at the mouth of the river Tweed. Several young birds were shot on the Northumberland and Durham coast, and in the river Tyne, in the winter of 1829–30.

186. COLYMBUS SEPTENTRIONALIS. RED-THROATED DIVER.

Colymbus septentrionalis, *Linn.*, *Lath.*, *Flemm.*, *Steph.*, *Selby.*
Plougeon cat-marin, ou à gorge rouge, *Temm.* Man. d'Ornith.
Red-Throated Diver, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. et Sup., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *&c.*

Young after one moult. { Colymbus stellatus, *Lath.*
Speckled Diver, Br. Zool., *Lath.* Syn., *Bewick's* Br. Birds.

Young 2d moult. { Colymbus striatus, *Lath.*
Striped Diver, Arct. Zool., *Lath.* Syn.

Family III. Alcadæ.

Genus URIA. GUILLEMOT.

187. URIA TROILE. FOOLISH GUILLEMOT.

Uria Troile, *Lath.*, *Steph.*, *Flemm.*, *Selby.*
Colymbus Troile, *Linn.*
Guillemot à capuchon, *Temm.* Man. d'Ornith.
Foolish Guillemot, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

Young. { Lesser Guillemot, *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Steph.*, *Shaw's* Zool.

188. URIA GRYLLE. BLACK GUILLEMOT.

Uria Grylle, *Lath.*, *Selby.*
Cephus Grylle, *Flemm.* Br. Anim.
Colymbus Grylle, *Linn.*
Guillemot à miroir blanc, *Temm.* Man. d'Ornith.
Black Guillemot, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

Winter Plumage. Young.
- Uria minor striata, *Briss.*
- Spotted Greenland Dove, *Lath.* Syn.
- Spotted Guillemot, Br. Zool., *Lath.* Syn.

Rare upon our coast. I have a single specimen in the winter plumage, killed near Holy Island. Two specimens shot on the Northumberland Coast last winter, were sent to Mr. Ellison, at the Turk's Head Inn, Newcastle.

Genus MERGULUS. ROTCHE.

189. MERGULUS ALLE. COMMON ROTCHE.

Mergulus Alle, *Selby.*
Mergulus melanoleucos, *Flemm.* Br. Anim.
Alca Alle, *Linn.*, *Lath.*, *&c.*
Guillemot nain, *Temm.* Man. d'Ornith.
Little Auk, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. and Sup., *Bewick's* Br. Birds.
Common Rotche, *Flemm.* Br. Anim.

Rare. The specimen in my collection was shot at Holy Island: others killed upon the coast are in the possession of different individuals at Newcastle.

Genus ALCA. AUK.

190. ALCA TORDA. RAZOR-BILL AUK.

Alca Torda, *Linn.*, *Lath.*
Pingouin macroptère, *Temm.* Man. d'Ornith.
Razor-bill Auk, or Murre, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.

Winter Plumage.
- Alca Pica, *Linn.*
- Black-billed Auk, *Lath.* Syn., *Mont.* Ornith. Dict. and Sup., *Bewick's* Br. Birds.

Genus FRATERCULA. COULTERNEB.

191. FRATERCULA ARCTICA. COMMON COULTERNEB.

Fratercula arctica, *Steph.*, *Flemm.*, *Selby.*
Alca arctica, *Linn.*, *Lath.*
Fratercula, *Briss.*,
Macareux moine, *Temm.* Man. d'Ornith.
Puffin, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.
Common Coulterneb, *Flemm.* Br. Anim.

Family IV. Pelecanidæ.

Genus PHALACROCORAX. CORMORANT.

192. PHALACROCORAX CARBO. COMMON CORMORANT.

Phalacrocorax carbo, *Steph.*, *Flemm.*, *Selby.*
Pelecanus carbo, *Linn.*, *Lath.*
Grand Cormoran, *Temm.* Man. d'Ornith.
Cormorant, or Corvorant, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim.,
Crested Cormorant, *Bewick's* Br. Birds.

193. PHALOCORAX GRACULUS. COMMON SHAG.

Phalocorax Graculus, *Flemm.*
Pelecanus Graculus, Gm. Syst., *Lath.* Ind., Arct. Zool.
Carbo Graculus, *Temm.* Man d'Ornith.
Common Shag, *Flemm.*
Shag, Arct. Zool., *Lath.* Syn., *Bewick's* Br. Birds, *&c.*

The eggs of this bird, which are now in the Newcastle Museum, were procured by Mr. George C. Atkinson, Esq., at the Fern Islands. Mr. R. R. Wingate, also procured the bird and eggs a few years ago, at the same place.

194. PHALACROCORAX CRISTATUS. CRESTED GREEN CORMORANT.

Phalacrocorax cristatus, *Steph., Selby.*
Carbo cristatus, *Temm.* Man. d'Ornith.
Pelecanus cristatus, *Lath.*
Cormoran largup, *Temm.* Man. d'Ornith.
Crested Shag, Arct. Zool., Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict. and Sup.
Crested Cormorant, *Steph., Shaw's* Zool., *Selby's* Illus. Br. Orn.

This species breeds upon the Fern Islands. The nest is placed in the clefts of the highest rocks.

Genus SULA. GANNET.

195. SULA BASSANA.

Sula bassana, *Briss., Flemm., Selby.*
Pelecanus bassanus, *Linn., Lath.*
Fou blanc, ou de bassan, *Temm.* Man. d'Ornith.
Soland Goose,
Gannet, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *&c.*
Solan Gannet, *Steph., Selby.*

Family V. Laridæ.

Genus STERNA. TERN.

196. STERNA CANTIACA. SANDWICH TERN.

Sterna Cantiaca, *Gmel.*
Sterna Boysii, *Lath., Flemm.*
Hirondelle-de-mer Caugek, *Temm.* Man. d'Ornith.
Sandwich Tern, *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm., &c.*
Greater Sea Swallow, *Albin's* Br. Birds.

A summer periodical visitant. Used to breed in great numbers at the Fern Islands, but within late years they have been driven from thence, and have now colonized Coquet Island.

197. STERNA DOUGALLI. ROSEATE TERN.

Sterna Dougalli, *Mont., Steph., Flemm., Selby, &c.*
Hirondelle-de-mer Dougall, *Temm.* Man. d'Ornith.
Roseate Tern, *Mont.* Ornith. Dict., *Steph., Shaw's* Zool., *Bewick's* Br. Birds, Sup., *Flemm* Br. Anim., *Selby's* Illus. Br. Orn.

In considerable numbers during the summer, at the Fern Islands.

197. STERNA ARCTICA. ARCTIC TERN.

Sterna arctica, *Temm.* Man. d'Ornith., *Selby*, in Zool. Journ.

Very numerous during summer upon the Fern Islands.

198. STERNA HIRUNDO. COMMON TERN.

Sterna hirundo, *Linn.*, *Lath.*, *Flemm.*, *&c.*
L'Hirondelle de mer pierre Garin, *Temm.* Man. d'Ornith.
Greater Tern, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Steph.*, *Shaw's* Zool., *Flemm.* Br. Anim.

A rare species upon our coast.

199. STERNA MINUTA. LESSER TERN.

Sterna minuta, *Linn.*, *Lath.*, *Flemm.*, *Selby*, *Steph.*
La Petite Hirondelle de mer, *Temm.* Man. d'Ornith.
Hooded Tern, *Lath.* Syn.
Lesser Tern, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Steph.*, *Shaw's* Zool. *Bewick's* Br. Birds, *Selby's* Illus. Br. Orn., *&c.*

They breed upon the coast near to Ross, upon the sandy isthmus called the Old Law, nearly opposite to Holy Island. The Messrs. Hancock's saw this bird, at the above place, in considerable numbers, this summer, and procured a plentiful supply of the eggs.

200. STERNA NIGRA. BLACK TERN.

Sterna nigra, *Linn.* Syst., *Lath.* Ind. Orn., *&c.*
Sterna fissipes et obscura, *Gmel.* Syst., *Lath.* Ind. Orn.
Hirondelle-de-mer épouvantail, *Temm.* Man. d'Ornith.
Black Tern, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *&c.*

A rare species in the north. A specimen in the collection of Messrs. Hancock, Newcastle, was shot at Prestwick Car.

Genus LARUS. GULL.

201. LARUS RIDIBUNDUS. BLACK-HEADED GULL.

Larus ridibundus, *Linn.*, *Lath.*, *Flemm.*
Mouette rieuse ou à capuchon brun, *Temm.* Man. d'Ornith.
Black-headed Gull, Br. Zool., *Lath.* Syn., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

202. LARUS CANUS. COMMON GULL.

Larus canus, *Linn.*, *Lath.*, *Flemm.*, *Selby*, *&c.*
Mouette à pieds bleus, *Temm.* Man. d'Ornith.
Common Gull, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Flemm.* Br. Anim. *Bewick's* Br. Birds., *&c.*

203. LARUS FUSCUS. LESSER BLACK-BACKED GULL.

Larus fuscus, *Gmel.*, *Lath.*, *Steph.*, *Selby*, *&c.*
Larus argentatus, *Mont.* Sup. Ornith. Dict.

Goêland à peids jaunes, *Temm.* Man. d'Ornith.
Herring Gull, Br. Zool., *Lath.* Syn.
Lesser Black-backed Gull, *Mont.* Ornith. Dict. Sup., *Selby's* Illus. Br. Orn., *Steph.*, *Shaw's* Zool., *&c.*

204. LARUS ARGENTATUS. HERRING GULL.

Larus argentatus, *Brunn. Selby, &c.*
Larus marinus var. *α. Lath.*
Silvery Gull, Arct. Zool., *Lath.* Syn.
Goêland à manteau bleu, *Temm.* Man. d'Ornith.
Herring Gull, *Lath.* Syn., *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn.

205. LARUS MARINUS. GREAT BLACK-BACKED GULL.

Larus marinus, *Linn.*, *Lath.*, *Flemm.*, *Selby, &c.*
Le Goeland noir manteau, *Temm.* Man. d'Ornith.
Black-backed Gull, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

206. LARUS GLAUCUS. GLACOUS GULL.

Larus glaucus, *Brunn.*, *Lath.*, *Sabine*, Trans. Linn. Soc., *Steph.*, *Shaw's* Zool., *Selby, &c.*
Goeland burgermeister, *Temm.* Man. d'Ornith.
Glaucous Gull, Arct. Zool., *Lath.* Syn., *Sabine*, Trans. Linn. Soc., *Steph. Shaw's* Zool., *Selby's* Illus. Br. Orn.

An occasional winter visitant, and mostly immature. A fine adult specimen was shot in February, 1830, near Holy Island, and is now in my collection.

207. LARUS ISLANDICUS. ICELAND GULL.

Larus Islandicus, *Edmonstone* in Trans. Wern. Soc., *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.
Larus argentatus (an Arctic var.,) *Sabine* in Trans. Linn. Soc., *Temm.* Man. d'Ornith.
Iceland Gull, *Selby's* Illus. Br. Orn., *Flemm.* Br. Anim.

Very rare. A specimen in my collection was shot at Holy Island.

208. LARUS RISSA. KITTIWAKE.

Larus Rissa, *Linn.*, *Flemm.* Br. Anim., *&c.*
Larus tridactylus, *Lath.*
Rissa Brunnichii, *Steph.*
Mouette tridactyle, *Temm.* Man. d'Ornith.
Kittiwake, *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *Selby's* Illus. Br. Orn.

Young. { Larus tridactylus, *Linn.*
Tarroch, Br. Zool., *Lath.* Syn. and Sup.

Genus CATARACTES. SKUA.

209. CATTARACTES VULGARIS, COMMON SKUA.

Cataractes vulgaris, *Flemm.* Br. Anim.
Lestris Cataractes, *Temm.* Man. d'Ornith.
Larus Cataractes, *Linn.* Syst., *Gmel.* Syst., *Lath.* Ind. Orn., *&c.*
Stercoraire cataracte, *Temm.* Man. d'Ornith.

Skua Gull, Br. Zool., Arct. Zool., *Lath.* Syn., *Mont.* Ornith. Dict, *Bewick's* Br. Birds, *&c.*
Common Skua, *Flemm.* Br. Anim.,

This species rarely appears so far to the south of its habitation. A specimen deposited in the Museum of the Society, was shot off Cullercoats.

210. CATARACTES PARASITICUS. ARCTIC SKUA.

Cataractes parasiticus, *Flemm.*, *Selby.*
Lestris parasiticus, *Temm.* Man. d'Ornith.
Arctic Gull, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds, *Flemm.* Br. Anim., *&c.*
Young. { Larus crepidatus, *Lath.*
Black-toed Gull, Br. Zool., *Lath.* Syn., *Mont.* Ornith. Dict., *Bewick's* Br. Birds.

211. CATARACTES POMARINUS. POMARINE SKUA.

Cataractes Pomarinus, *Temm.* Man. d'Ornith., *Shaw's* Zool.
Stercorarius striatus, *Briss.* Orn.
Pomarine Gull, *Lath.*, Gm. Hist.
Pomarine Skua, *Shaw's* Zool., with fig. of young.

A rare species in the adult plumage. About two years ago a specimen was killed on the river Tyne, and is now in the possession of Mr. Marshall, of Newcastle. Two birds were also shot by Mr. Ed. Backhouse, off the Durham coast, which in all essential particulars answered the description of this species.

Genus PROCELLARIA. PETREL.

212. PROCELLARIA BULLOCKII. FORK-TAILED PETREL.

Procellaria Bullockii, *Flemm.* Br. Anim.
Procellaria Leachii, *Temm.* Man. d'Ornith.
Leach's Petrel, *Selby's* Illus. Br. Orn.

A specimen of this Petrel was shot at Benwell Boat-house, November, 1828, by Geo. C. Atkinson, Esq.

213. PROCELLARIA PELAGICA. STORMY PETREL.

Procellaria pelagica, *Linn.*, *Lath.*, *Flemm.*, *&c.*
Pétrel tempête, *Temm.* Man. d'Ornith.
Stormy Petrel, Br. Zool., *Lath.* Syn. Id. Sup., *Mont.* Ornith. Dict., *Selby's* Illus. Br. Orn.

Genus PUFFINUS. PUFFIN.

214. PUFFINUS ANGLORUM. MANKS PUFFIN.

Puffinus anglorum, *Raii.*, *Steph.*, *Flemm.*, *&c.*
Procellaria puffinus, *Briss.*
Pétrel Manks, *Temm.* Man. d'Ornith.
Shearwater Petrel, Br. Zool., *Mont.* Ornith. Dict., *Lath.*, Gm. Hist.
Manks Shearwater, *Steph.*, *Shaw's* Zool.
Manks Puffin, *Flemm.* Br. Anim.

Very rare. The only fresh specimen I ever obtained was one killed upon an excursion to the Fern Islands.

Birds supposed to have escaped from Confinement on Gentlemen's Ponds and artificial Pieces of Water, &c.

ANAS CANADENSIS, CANADA GOOSE.

Anas canadensis, *Linn.*, *Lath.*, *Raii.*, *Briss.*, *&c.*
L'oie à cravate, *Buff.* Ois.
Canada Goose, Arct. Zool., *Lath.* Syn., *Steph. Shaw's* Zool.

In June, 1816, a flock of ten or twelve of these birds, for some time haunted the fields around Bamburgh. They were very wary and wild, and the only specimen killed out of the number is now in my collection. They had probably escaped from the grounds of some gentleman. I have ascertained from those who have been in the habit of keeping them in their ponds, that they are very apt to fly and stray away.

CHENELOPEX ÆGYPTIACA. EGYPTIAN SPUR-WI NG.—Steph.

Anas Ægyptiaca, *Linn.*, *Lath.*, *Briss.*
L'Oie d'Egypte, *Buff.* Ois.
Egyptian Goose, *Lath.* Syn.,

Five of these birds appeared upon the Fern Islands early in April, 1830; three of them were killed by the keeper of the light-house, after repeated discharges, two of which were sent to the Museum of the Society, the third came to Twizell-house. On the following day, another was picked up dead at sea, by a boat belonging to Holy Island, and sent to me; it proved a fine male, and in excellent condition. At Gosforth, the seat of the Earl of Wemyss, upon the Frith of Forth, great numbers of these birds are kept in the artificial pieces of water, and unless pinioned are very apt to fly away

March, 1831,—I received, a few days ago, another specimen of this species, which was killed near Berwick upon Tweed: it proved a female, upon dissection. I still am of opinion that these are individuals which have quitted Gosforth, in Haddingtonshire, or some other gentleman's park.

The Eagle mentioned at page 245 as being shot near Morpeth, was presented to the Society by Mr. John Moore, of Morpeth High House.

A very fine specimen of the Roller, now in the possession of a person at Gilsland, was shot near that place a few months ago.

No. XXVI.—*Notice of Cypselus alpinus, and Mergus cucullatus.*—*By P. J. Selby, Esq., F. R. S. E., &c. &c. &c.*

Read, March 21, 1831.

As acquisitions to the British Fauna, in whatever department, are at all times interesting to the naturalist, I make no apology for laying before the Society a short notice of two birds, both new to Britain, one of which is entitled to be placed immediately upon the list of our birds, as an occasional visitant, and the other, I hope, will be proved, during the course of the ensuing summer, a regular periodical visitant upon the southern coast of the sister island. The first I shall mention is the *Cypselus alpinus*, of Temminck (Alpine Swift), a bird well known upon the Continent, in Switzerland and other mountainous countries, as well as upon the rocky coasts of the Mediterranean. A specimen of this bird was lately sent to me by William Sinclaire, Esq., of Belfast, and was shot by an acquaintance of his within eight miles of the south coast of Ireland, on his passage from the West Indies to the port of Belfast. This gentleman further informed him, that some of the pilots, belonging to Cape Clear, on board his vessel at the time, appeared to know it, and at once gave it the name of the *Cape Thrush*. Mr. Sinclaire then proceeds to observe, "that from the period of the year at which the specimen was obtained, viz., midsummer, and from the natives of the coast appearing to have a knowledge of the bird, I am inclined to think, that it may possibly be found there during the period of incubation, especially as the locality would agree with the habitat assigned it by Temminck, who says, it is found in abundance along the rocky coast of the Mediterranean." In this supposition I readily concur, knowing the restricted localities to which certain species confine themselves, as exemplified in the Pied Fly catcher, Lesser Whitethroat,

Reed Wren, &c. &c., and also taking into consideration the comparatively unexplored state of that district of Ireland it is supposed periodically to visit, and I therefore almost confidently anticipate a successful issue to the enquiries Mr. Sinclaire has undertaken to institute during the course of the ensuing summer.

The other, which we may claim as an acquisition, is, the *Mergus cucullatus* (Hooded Merganser), upon the authority of a specimen, killed at Yarmouth, in Norfolk, in the winter of 1829. The skin of this individual was lately sent to me by my esteemed correspondent, Mr. Elton, of Redland, near Bristol, to whom it was presented, by a friend, who purchased it as a rare variety, in a *fresh state*, from the person who actually shot it. From the state of its plumage, it appears to be a young female, the crest not being so full or large, and the white upon the secondary quills less extended than in the skin of an adult female compared with it. From the defective description of the female in Wilson's *Amer. Ornithology* and other works, I was, at first, in considerable doubt as to the species, and was almost inclined to think it new, or one very nearly allied to *Mergus fuscus*, of Latham, Pennant's Brown Merganser, which, indeed, I believe to be no more than the young male of *M. cucullatus;* but a skin of an adult female, sent for comparison by Sir Wm. Jardine, immediately removed all doubt upon the subject, as the only differences observed were such as I have mentioned a little above. The following is a correct description:—Length, about 18 inches; bill, one inch and a half, rather slender, and not nearly so thick at the base as in the Smew, the serratures broad and flat, it appears to have been of a reddish brown at the base, the tip and nail darker; the chin is greyish white, speckled with greyish brown; and the whole of the face, cheeks, and neck of an uniform greyish brown or mouse colour; the crown of the head darker, and the occipital crest large and semicircular, composed of long lax feathers, of a pale reddish brown tinged with grey; the upper part and sides of the breast deep pearl grey, the margins paler; the upper back and wing coverts are greyish black, the feathers margined with obscure greyish brown; the scapulars and lower back

are black; the margins of four or five of the secondary quills are white, and form a small spot or speculum in the middle of the wings; the quills and tail are greyish black; the lower part of the breast, belly, and abdomen, pure white, with a silky lustre; the sides and flanks deep brownish grey; the legs and feet are now reddish brown. The tarsus measures just one inch in length.

No. XXVII.—*A Description of a Fossil Tree, discovered in the Quarry of Craigleith, near Edinburgh, in the Month of November*, 1830.—*By Henry Witham, Esq., F. G. S., &c. &c.*

Read, March 21, 1831.

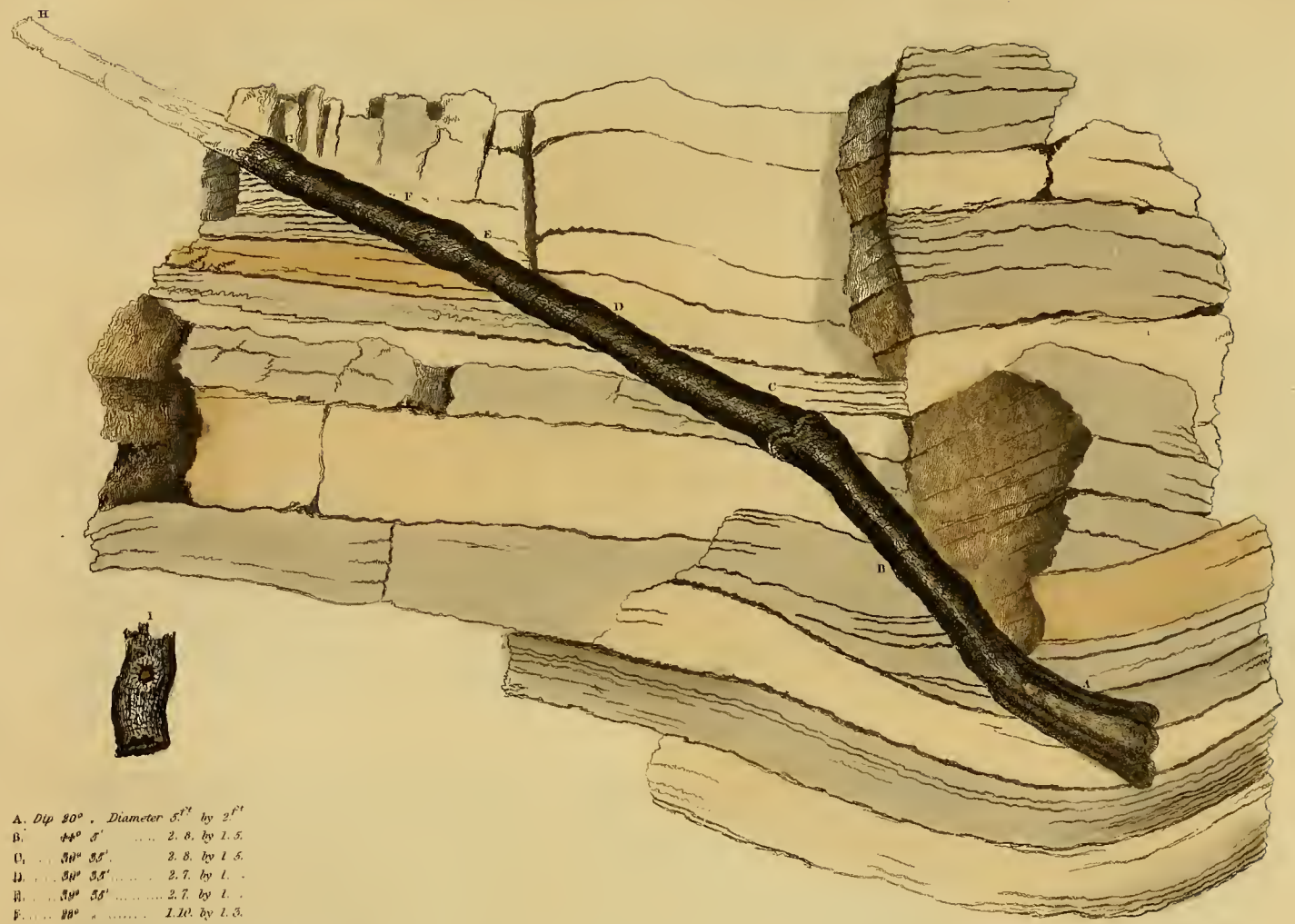
In the month of November last year, a magnificent Fossil Stem was discovered in the quarry of Craigleith, near Edinburgh, which, in geological position, is situate in the Mountain Limestone group, and lies considerably below the great Coal basins of the Lothians. Its elevation above the medium level of the sea, by barometrical measurement, is 75 feet. In the part of the quarry in which the Fossil is situate, the strata incline to the N. N. E. 1 foot in 4½. This part of the quarry, from some unforeseen cause, assumes a trough-like shape, the one side dipping at an angle of 20° to the south, and the other side, at an angle of 20° to the north. At the bottom of this basin, lay the roots of this splendid Fossil. The general direction of the tree is 20° W. by N., and the dips are as follow:—A B at an angle of 20°, B C 44° 5′, C D E 39° 35′, F 28°, G 28°. (*See* Plate XXIV.)

The length of the stem from the top to the root was 47 feet. It presents the appearance of a large branchless trunk, in some parts greatly flattened, so as to form an elliptical section. The diameters are nearly as follow, and will best shew the places and proportions of such flattenings:—

	Ft.	*In.*		*Ft.*	*In.*	
A.....	5	0	long diameter, and	2	0	short ditto.
B C.....	2	8	long diameter, and	1	5	short ditto.
D E	2	7	long diameter, and	1	0	short ditto.
F	1	10	long diameter, and	1	3	short ditto.
G.....	1	7	long diameter, and	1	4	short ditto.

On the edges of the latter diameter it was not more than 7 inches.

PLATE XXIV.



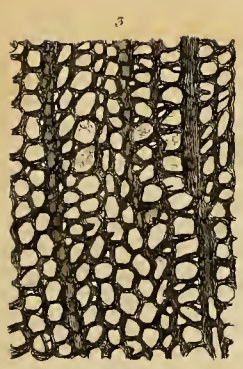
A. Dip 20° . Diameter 5.ft by 2.ft
B. 44° 5' .... 2. 8. by 1. 5.
C. .. 30° 35'. 2. 8. by 1. 5.
D. ... 30° 35' ..... 2. 7. by 1. .
E. ... 30° 35' ..... 2. 7. by 1. .
F. .... 28° " ..... 1. 10. by 1. 3.
G. ..... 28° " ..... 1. 7. by 1. 4.
H. Supposed prolongation of the top of the stem. 12 feet
I. Upper part of the tree first discovered, shewing a cavity, the seat of a branch.
Length from A to G 47 feet.

FOSSIL TREE IN CRAIGLEITH QUARRY,
Discovered Nov.r 1830.

Drawn by W. Mac Gillivray

Engraved by W. H. Lizars

PLATE XXV.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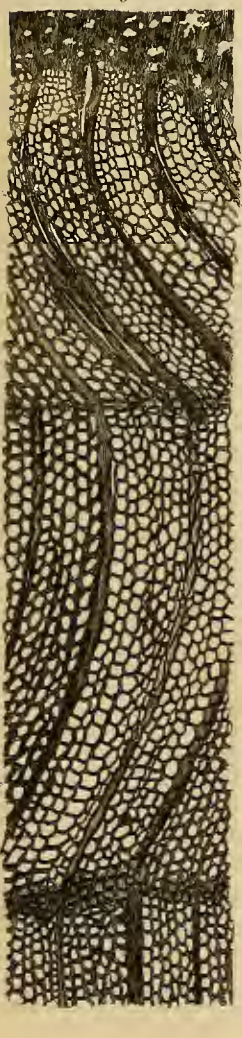
7

5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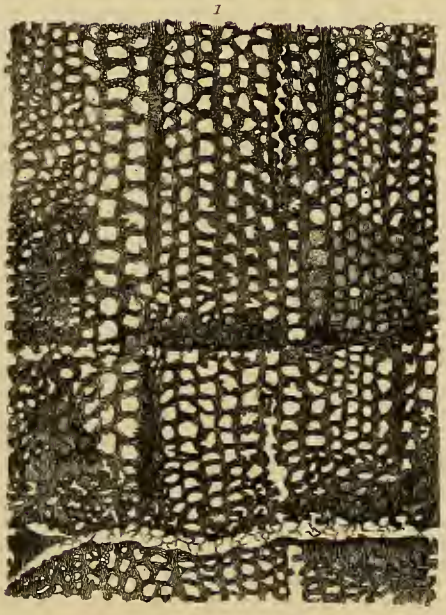
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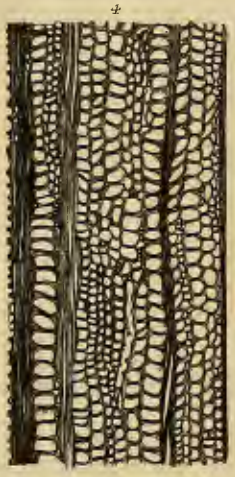
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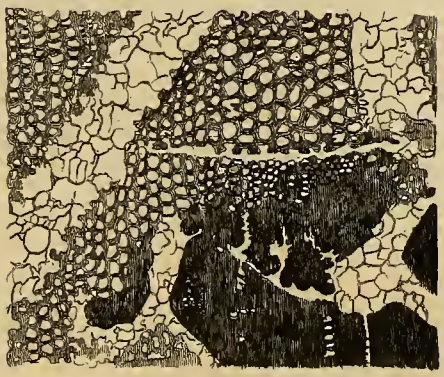
6


2

Drawn by W MacGillivray

MAGNIFIED SECTIONS OF FRAGMENT OF BRANCH OF FOSSIL TREE.
Discovered in Craigleith Quarry in 1831.

Engraved by W.H.Lizars

From the diameter of the highest part mentioned, it appears quite evident, that many feet of the top part of the stem must have been taken away unobserved ere it attracted the notice of the public, leaving fair ground to conclude, that, when it waved in the winds which whistled through its spreading branches, for aught we can say, a million years ago, its magnificent trunk stood tall and stately full 60 feet in height. Judging from the unworked rock near where the stem lies, the superincumbent mass must have been above 100 feet. The stem tapers gradually, and is marked at irregular intervals with a kind of transverse rugæ or irregular prominences. The bark has been converted into Coal, and presents indistinct longitudinal markings, with very small transverse ridges. At some of the prominences the rugæ are contorted like the coming off of branches of various pine plants.

That the forms of Fossil Trees are frequently much altered prior to their consolidation, or during the process of petrifaction, there can be no doubt. The shapes themselves, and the circumstances in which they are discovered, often sufficiently bear evidence to the fact, that pressure and other agents have been at work. But recourse has often been had to this mode of explanation in cases where it could not apply, and where one much more easy was at hand. It is by no means uncommon to find amongst recent trees, forms similar to those of Fossil plants, which have been ascribed to pressure and other external causes. Every one who has had the opportunity, and has availed himself of the occasion, must have observed this. The flattening, therefore, of this Fossil Tree is only similar to what exists in living nature, although I am unwilling to believe that to be the case in this splendid instance of early vegetation. The usual way of accounting for such flattenings is by pressure, although, in the present case, where the Tree is not parallel to the strata, it is rather difficult to suppose its form to be owing to that cause. The pressure by loose sand, or by sand mixed with water, would act all round the stem, and so would not flatten it; but if we suppose, that the Tree, in its recent state, was carried along by a torrent of water and sand, and left sticking, as the latter consolidated, it would afterwards begin to decay, when the hardened strata

would necessarily press down upon it, and so produce the flattening; and those parts of the stem which decomposed rapidly, would naturally shew the effect of pressure most, and such I believe to have been the case with the Fossil stem under consideration.

In the great Coal-field of the north, Fossil plants are generally found in a horizontal position, or parallel to the strata, in the greatest possible confusion, much broken, much compressed, and with their parts far separated. Indeed the confusion is the most serious difficulty the observer has to contend with. It is, however, by no means easy to trace the operation of a current of water that has swept off weaker vegetables, and deposited them where we now find them so beautifully preserved. Notwithstanding this, there are to be found in considerable abundance in various positions, large and strong trunks of plants which appear to remain in their natural positions, and which have been able to withstand the force of such torrents, if it can be proved that any such existed. These vertical plants are generally found to be *Sigillariæ*. The *Stigmariæ* of Brongniart (the *Lepidodendra* of Sternberg), and the *Equisetaceæ* on the contrary, do not appear to have been sufficiently strong, to have resisted such revolutionary influence.

Several scientific gentlemen having stated as their opinion, that this Fossil is a *Lycopodium*, I may here mention the reasons why I have come to a different conclusion. 1st. From external appearance. In this plant there are no appearances of insertions of leaves on any part of it, or any markings similar to the scales of Palms, or Ferns, or the imbricated leaves of the *Lycopodium*. Judging alone from external appearances, the probability is, that it is a stem of a Dicotyledonous, or Gymnospermous Phanerogamic plant. 2d. From internal structure. Having examined, with care, the internal structure of this Fossil Tree, under the microscope, agreeably to the rules laid down in my *Observations upon Fossil Vegetation*, I find it cannot belong to the former of these classes. It has, however, most decided medullary rays and a woody texture, with some appearance of concentric circles, and must therefore belong to the order *Coniferæ*. (*See* Plate XXV. Figs. 1 and 2.) It cannot be a *Cycas* or a *Zamia*, and a *Lycopodium* it cannot possibly

be, these plants being Vascular Cryptogamic, composed of cellular tissue with vascular fibres, destitute of medullary rays, concentric rings, or woody texture, and generally dichotomous. Great numbers of these Gymnospermous Phanerogamic plants have lately been discovered in the Shales of the Mountain Limestone groups, much broken, and lying in a state of great confusion. This gigantic stem so far exceeds in size the generality of those found in similar situations, that although possessing, in common with the rest, the same generic character, yet, I fear, with our present limited knowledge in this hitherto neglected field of Botany, it would be dangerous, or rather impossible, to name the species. I may here mention, that the concentric rings, so very apparent in plants belonging to the Oolitic series, are not in general so conspicuous in those found in the Mountain Limestone series and Coal-fields; probably amongst other causes, owing to the abundance of Calcareous matter, and the peculiarity of crystallization. Yet, from the examination of the few slices of this Tree already cut, I feel persuaded that they will be found in many parts of its magnificent trunk.

Since commencing this short account, a fragment of a third Fossil stem, with a branch, has been discovered, on the south side of the same quarry, between where the Fossil discovered in the year 1826 and that found in 1830 lay. This fragment and branch were embedded in one of those indurated parts of the rock, called by the workmen, "kettle-bottoms." The rock being so hard, it became necessary to blast it, which probably detached the branch from the fragment of the stem. The branch has been sliced, and shews the concentric rings, in a perfection almost approaching to the Fossils belonging to the Oolitic series. (*See* Plate XXV. Figs. 3, 4, 5, 6, 7, and 8.) The pith is large. This is the most powerful link which has been found to unite the chain of evidence, which in every other respect is so strong, in favour of these plants belonging to the Phanerogamic class.

Two immense *Coniferæ*, and a fragment, found within 400 yards of each other, afford strong reason to think, that in a square mile of the same deposit, many of these ancient relics of early vegetation will be

brought to light, and leave room to believe, that these plants, are as abundant in these deposits as in those higher up in the series.

Another singularity to be accounted for is, the difference in composition of these Fossils from the surrounding medium. When we find, in beds of Sandstone, vegetable forms of Vascular Cryptogamic plants transmuted into a substance of a similar chemical nature, the presence of the Sand, and the decay of the vegetable matter, afford an easy explanation of the manner in which the transmutation has been effected; but when the petrifying substance is different in nature from that forming the matrix of the Fossil, difficulties occur. Yet if we take the whole mass or group of substances constituting any one formation, we may find means of accounting for the fact in a tolerably satisfactory manner. For instance, large Fossil Trees are found in the Mountain Limestone groups. In this series we have abundance of Lime for our purpose, and the reason why the Sandstone contains less Lime than the Fossil, appears to be, that before the strata were consolidated, the Sand being more incoherent than the Wood (although we must suppose the latter in a decayed state), the Lime found a more easy passage through it, and was not, therefore, retained in such great quantity as in the Fossil, which being denser and in a state of decay, as the vegetable matter decomposed, the Calcareous matter filled it up. Again, on the contrary, those Fossils, found in the Coal-field proper, having the Mountain or Carboniferous Limestone for its base, and the Magnesian Limestone, or new Red Sandstone series, lying immediately above it, contain little or no Lime, as will be seen by the different analyses hereafter to be mentioned. It having been ascertained by analyses, that the *Coniferæ* of the Coal-field differ widely in composition from those found in the Mountain Limestone group; the latter containing large portions of Carbonate of Lime, much Iron, and small quantities of Carbon; the former being composed almost entirely of siliceous matter, with scarcely any other foreign substance;—the conclusion to be drawn from these marked differences in their component parts, becomes to the practical miner of considerable importance. As in many of the sedimentary

deposits we are enabled, by certain species of shells, which are embedded in them, to ascertain their precise geological nature (as, for example, in the case of the Oolitic formation of Brora in Sutherland, resting upon Red Granite), so may we now, I hope, by the obvious distinction between these Fossil plants, possessing distinct structure, be enabled, at once, to ascertain the group of rocks to which they belong. Should similar analysis be taken of the Fossil vegetables possessing structure in other Coal-fields and Mountain Limestone groups, and the results prove equally satisfactory, a new light will beam upon the bewildered miner, and large sums of money be saved to the owners of such sedimentary deposits. The following is the analysis of the Craigleith Fossil above described.

Specific gravity,	2.87
Carbonate of Lime,	62 per ct.
Carbonate of Iron,	33 ditto.
Carbon,	5 ditto.
	100

Analysis of the Craigleith Tree found in 1826.

Carbonate of Lime,	60 per ct.
Oxide of Iron,	18 ditto.
Alumine,	10 ditto.
Carbon,	9 ditto.
Loss,	3
	100

Analysis of the fragment and branch found in Craigleith in 1831.

Lime,	37.5
Peroxide of Iron,	24.2
Coal,	38.1
	99.8

Dr. Gregory, who has been kind enough to examine the abovenamed Fossil, has favoured me with the following remarks upon it:—"The Iron does not exist in the state of peroxide in the mineral. If reduced to protoxide, it would amount to 21.8 p. c., and the loss would be 2.4 p. c. of which a part is water. The Coaly matter is, like ordinary Coal,

partly volatile, yielding inflammable gas and bituminous matter by heat. The residue is nearly pure charcoal = nearly 14.3 p. c. The mineral contains very minute traces of Silica and Alumina. The other fragments have a similar composition, only the Lime is more abundant from the presence of some crystals of Limestone which it is impossible to separate completely."

Analysis of Fossils found in Berwickshire.

Carbonate of Lime,	78.25
Peroxide of Iron,	16.50
Protoxide of Iron,	3.40
Loss,	1.95
	100.00

All these were found in the Mountain Limestone groups. In different parts of the tree we will come to somewhat different results respecting the proportions of the abovenamed substances.

The following is the analysis of the vegetable Fossils found in the Coal-field, or, in other words, lying between the Encrinal or Mountain Limestone, and the new Red Sandstone deposits.

Fossil found in a quarry at Heworth Shore, near Newcastle.

Silica,	95 per ct.
Peroxide of Iron and Alumine,	5
	100

The following remarks were kindly transmitted to me by Mr. James Johnston, of Portobello, upon the Wideopen Fossil, and that at High Heworth, near Newcastle.

"The fragments of the two Fossils transmitted to me have the same external characters. Both are of a dark brown, from the presence of peroxide of Iron in a very insoluble state. About one-half of the mass of both consists of Silica in a crystallized state (common Quartz crystals), presenting in the cavities beautiful groups of crystals of the common form. The cavities in the High Heworth tree are more frequent and regular, forming parallel fissures, separated by thin walls of a more compact body, running in the direction of the fibres of the original

wood. Under the microscope, the more compact part, portions of which occur here and there of considerable size, is seen to be composed of similar crystals, embedded in a brown amorphous substance. This brown substance prevails more in some parts of the Fossil than in others; a difference due probably to the manner in which the decay of the wood took place—but shewing that any two portions of the Fossil mass, taken without selection, must vary considerably in composition. With acids this solid portion exhibits no effervescence, nor is it dissolved by long digestion; the Lime only, and a small quantity of Iron, are taken up by this treatment. Reduced to a state of coarse powder, which contained necessarily many fragments of the crystallized Quartz, a portion of the Wideopen Fossil gave *one per cent.*, and of the High Heworth Fossil *one-half per cent.* of Carbonate of Lime. The rest consisted of Silica, a variable portion of Alumine, and two or three per cent., probably, of peroxide of Iron. As the whole Fossil is a *mixture*, only, of these different substances, of which Silica is the predominating ingredient, forming, perhaps, four-fifths of the entire mass; and as it would be nearly impossible to obtain any part of the compound or amorphous portion free from crystallized Quartz, any analytical attempt to estimate the relative proportions of these ingredients would be useful only in regard to the fragment actually reduced to powder and analyzed; any other portion would be likely to give very different results. I have, therefore, considered it sufficient to determine that the Lime forms a very small, and the Siliceous matter a very great, proportion of the whole substance."

Here, then, we have strong and distinctive marks of differences between the plants found in the Coal-field, and those which occur in such abundance in the deposits immediately below it.

In conclusion, I beg to add, we have in this striking and stupendous relic of ages long gone by, an additional proof, amongst many others lately advanced, that plants belonging to the Gymnospermous-Phanerogamic class, are much more abundant in these early sedimentary deposits, than continental writers would lead us to believe.

No. XXVIII.—*On the Geology of a Part of Northumberland and Cumberland.—By Mr. Nicholas Wood, Killingworth.*

Read, April 18, 1831.

The great Coal deposit of Durham, and the south-eastern part of Northumberland, is that which is generally denominated the "Independent Coal Formation." The following being the order of superposition :—

No. 1.

Magnesian Limestone, underlaid by a bed of Yellow Sand, and Red Sandstone.

Reposing unconformably upon :—

No. 2.

Coal Measures,
Millstone Grit and Shale,
Mountain or Carboniferous Limestone,
Old Red Sandstone.

This arrangement is faithfully exhibited in the Geology of the district, the subject of this paper, in which it will be attempted to describe the successive cropping out of the second class of strata, from underneath the former, along the eastern coast of Northumberland, from the river Tyne to the Tweed; and again at right angles to that line, or from the sea at Tynemouth, to the New Red Sandstone Plain of Carlisle.

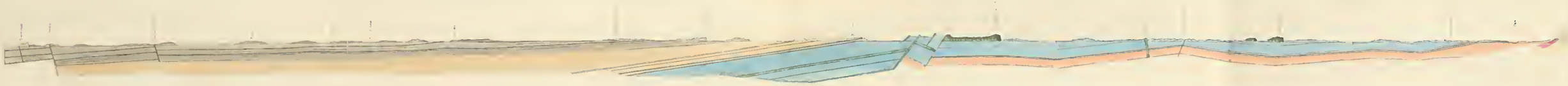
Independently, however, of the interest necessarily attaching to a correct record, of the locality and order of super-position of the several sub-divisions of the above series, there are some peculiarities incident to

PL. XV.

COAST SECTION FROM THE RIVER TYNE TO THE RIVER TWEED.

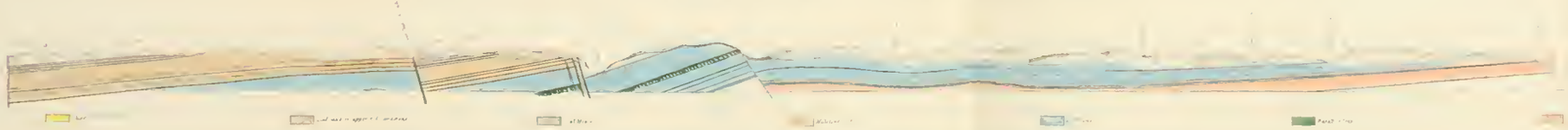
Shields

№1 SECTION FROM THE RIVER TYNE TO THE RIVER TWEED.



№2 SECTION FROM TYNEMOUTH TO TINDALE FELL.

№3 SECTION ACROSS THE STUBLICK DYKE TO THE HEAD OF NORTH TYNE.



PL. XXVIII

SKETCH
in
ILLUSTRATION OF THE PAPER
on the
GEOLOGY
OF
NORTHUMBERLAND.

the second class of strata as exhibited in this district, contrary to the received opinion of Geologists, which it shall be my object to elucidate.

It is considered characteristic of the suite of rocks, No. 2, that the great beds of Coal occur in the upper part of the series. Messrs. Conybeare and Phillips, in their work on the *Geology of England and Wales*, speaking of this, state, "Although it is true, that in Northumberland traces of Coal occur near the bottom of the Limestone deposit, still the general rule holds good there also, for the upper part of the series, in that county, contains frequent and thick seams of Coal, and in that part no Limestone is found: then after an interval of an intermediate character, corresponding to the Millstone Grit and Shale formation of Derbyshire, containing Sandstone and Shale, with two or three thin beds of Limestone and Coal, follows the great Limestone deposit, containing eighteen beds, many of them of considerable thickness, separated by Shale and Sandstone; and, lastly, the old Red Sandstone.—This part of the series contains only two thin and unworkable seams of Coal; for the Coal-beds which are found associated with Limestone in the north of Northumberland, belong to the intermediate formation between the Limestone and regular Coal Measures; so that here there is in fact no exception to the general rule; for all the workable Coal is above the great central Calcareous deposit, and below it are only imperfect traces of Coal, and those of the rarest occurrence."—Note, p. 312.

In accordance with this view of the Geology of Northumberland we find, on a reference to their Map, that the whole of the county, west of a line from the Coquet to the Tweed, up to the base of the porphyritic hills of the Cheviot, is denominated "Millstone Grit;" and this formation is made to stretch in a south-west direction, to the New Red Sandstone deposit of Carlisle: while to the north it is made to surround a patch of New Red Sandstone, forming the vale of the Tweed. The great series of beds of the Mountain Limestone is, on the contrary, confined to an almost insulated tract, south-west of a line from Morpeth to Carlisle.

The very useful Map of Greenough, exhibits nearly the same

arrangement of position. The vale of the Tweed is laid down as New Red Sandstone, the great Limestone deposit is confined to the same limited range, while the extensive moorland district of Northumberland is characterised as thick beds of Grit and Limestone, denominated in the tabular account as Hazel Post, Mountain Limestone, and Post, but distinguished and coloured different from the Mountain Limestone of Alston and Derbyshire, though it is remarked, that "the relative position of this group is not corrrectly ascertained."

Having had frequent opportunities, in the course of professional practice, of becoming acquainted with the geological position of some of the Coal-beds, associated with the Mountain Limestone of Northumberland, and having found many reasons for suspecting the accuracy of the views taken by these authorities, I was induced in 1826, to undertake an examination of the strata exhibited along the sea coast, from the Tyne to the Tweed, for the purpose of endeavouring to determine the relative position of the different Coal-beds, and more particularly those occurring near the mouth of the Tweed.

I now offer to the notice of the Society a section of the strata exhibited along the line of the coast, from which, together with an east and west section from the coast at Tynemouth to the New Red Sandstone near Carlisle, and another north and south section across the Stublic Dyke, I shall endeavour to show,

1. That the regular Coal Measures, which in all the Geological Maps are made to terminate on the west at or near Hedley Fell, stretch in a narrow zone into Cumberland.

2. That the great central beds of Mountain Limestone contain frequent and thick beds of workable Coal; and that the most extensive deposit of this mineral, below the Millstone Grit, occurs near the bottom of the series.

3. That the Red Sandstone of the Tweed is not referable to the New Red Sandstone conglomerate, as coloured by Greenough, but is a Red Sandstone which underlies the Mountain Limestone and the Coal-beds near the Tweed.

Section, Plate XXVI., is a bird's-eye view of the strata along the

line of the coast from the Tyne to the Tweed; the length on a scale of two inches to a mile; the heights are arbitrary, being extended in many cases for the purpose of shewing the more minute particulars, which a rigid adherence to a scale would have rendered diminutive. From this Section I shall, first of all, trace the various beds which basset along the line, and shall then endeavour to identify some of the most prominent strata, with the members of the series, to which I conceive they belong.

The coast of Durham exhibits cliffs of the Magnesian Limestone, with few interruptions, from Hartlepool to near the Tyne. Crossing that river, and commencing at the south end of the Section, we find under the castle at Tynemouth, a cap of the same Limestone, with its accompanying Yellow Sand and Red Sandstone, reposing unconformably upon the Coal Measures. A Whin Dyke, shewn in the Section, from 12 to 14 feet in width, and differing in no respect from those generally found in this district, here intersects the Yellow Sand and Red Sandstone, at right angles to the stratification of the beds; but it cannot, from the incumbent alluvial matter, be ascertained if it also pierces the Magnesian Limestone. The Coal Measures here, consist of the common Sandstones and Shale, rising gently north, with a seam of Coal cropping out at the north extremity of the cliffs.

Proceeding north, the next rocks which present themselves are near Cullercoats, and here we find the Slip Dyke, so well known in the Coalfield as the 90-fathom Dyke, run into the sea. The strata are here depressed on the north, or dip side of the Dyke, at least 90 fathoms; and here we again find the Limestone and Yellow Sand reposing against the north face of the slip, which the rise in the beds from Tynemouth had thrown out. The course of the Dyke here is about N. 42° W., and for some distance from the coast to the west, we find the Magnesian Limestone lying nearly horizontal upon the inclined edges of the Coal Measures, along the dip side of the Dyke. It is scarcely necessary to state, that this slip must be of subsequent date to the deposition of the Magnesian Limestone, as that bed is equally affected with the Coal Measures.

From this Dyke the inclination of the beds is at first rather rapid,

when they gradually assume a steady and moderate rise to the north ;— with trifling undulations they continue nearly flat to Hartley, where another Basaltic Dyke cuts through the beds. The Coal in the cliffs is charred, but the passage of the Basalt through the beds is not distinctly exposed, partly by the disintegration of the strata, and partly from its apparent connection with a Slip Dyke.

From Seaton Sluice, a sandy beach occurs, until we cross the Blyth, on the north side of which a few beds of the Coal Sandstones appear, rising towards the sea at an angle of 5°. The general position of the strata between these two places is, however, nearly flat, as the same beds of Coal are worked at Hartley and Cowpen Collieries.

The coast from Blyth for a considerable distance north consists of sandy dunes, until opposite North Seaton, where we find a very thick bed of White Sandstone, with two layers of Coal and Shale, the upper part of the Sandstone being quarried for grindstones. Beyond this is Newbiggen Bay, on the north side of which, a reef of gritty Sandstone rocks stretches into the sea, rising north about 1 in 6.

To the north of Newbiggen for some distance, the coast is very low with occasional rocks of Sandstone and Shale, of the Coal Measures, dipping gently north, with appearances of Slip Dykes in several places. At Hadstone a reef of Red Sandstone occurs, coarse and gritty, composed of Quartz coloured by a ferruginous cement ; line of direction S. 60° E., dip 1 in 12 north. Upon this lie beds of Shale and finer-grained Sandstones. Passing over a sandy beach, we find at Hawksley coarse Sandstone rocks of the Coal Measures, rising north 1 in 12, which extend with little interruption to the river Coquet, where they terminate. The Island of Coquet, opposite here, seems a continuation of the same beds of Sandstone.

The coast north of the Coquet for about one mile and a half is entirely sand, with high bent hills, when a bed of very hard and coarse Sandstone occurs, rising north about 1 in 15, underneath which are indications of thin layers of Coal and Bituminous Shale. A little way further north, the beds rise more rapidly. Between this and the harbour of Alemouth is a flat sandy beach, which extends beyond the

harbour for a short distance also, when we meet with coarse gritty Sandstone rocks rising north.

From the commencement of the Section to and beyond the Coquet, those rocks which have withstood the action of the sea, viz.: the coarse Sandstones and Shale, are clearly referable to the Coal Measures. How far beyond the mouth of the Coquet the Coal Measures extend, could not be ascertained, but the rocks midway between that river and Alemouth shew, that they do extend beyond that place. After passing the flat sandy beach, north of Alemouth, the rocks, however, assume a quite different character, the Sandstones become more decidedly gritty, consisting of large grains of rounded, and frequently pieces of angular, Quartz, agglutinated by a ferruginous cement, and presenting every characteristic of the "Millstone Grit."

The first group of these rocks, called the Alemouth rocks, are low, rising north, 1 in 8 or 9, accompanied with thick beds of hard black Shale. An interval of sandy beach then occurs, beyond which a reef of rocks stretches into the sea, called the Seaton or Bally-car Rocks, these consist of a thick bed of very coarse gritty Sandstone, with large angular fragments of Quartz imbedded. From this, northward to Boulmer, beds of Grit and Shale alternate, rising north; when the first observable bed of Limestone occurs, from 4 to 5 yards thick, abounding in Encrinites and Bivalve Shells, corresponding in every respect with the blue Encrinal Limestone of the Lead Measures. Line of direction, N. 70 E., rise north 10°.

Underneath the Limestone lies a hard marly Sandstone, then thin beds of Plate, containing muscle shells in abundance, below which are beds of Plate and Sandstone alternating, rising north, with a bed of Coal, apparently from 20 to 30 feet below the Limestone. Similar alternations of Shale and Sandstone take place to Boulmer Point, when a small bay occurs, the north side of which exhibits the beds of Sandstone much contorted and disturbed by Slip Dykes.

A little beyond this, and nearly opposite Howick, a Slip Dyke of considerable magnitude occurs, throwing in a bed of black Limestone, several yards thick, resting on Plate, and dipping north 20°. Upon

this Limestone lies a bed of very white Sandstone, through which a Basaltic Dyke passes without altering the position of the beds. The direction of this Dyke is N. 83 W., and it passes through the beds of Limestone and Sandstone, nearly at right angles to the line of stratification, or 70°. Upon the Sandstone rests another thick bed of dark blue Limestone, very much contorted and wavy, with thin beds of Shale interposed between the planes of stratification.

This bed of Limestone abuts against a confused mass of Basalt and displaced Sandstone, the position of which will be best comprehended by a reference to the Section. This broken and confused mass of Basalt and Sandstone, is terminated by a great body of Whin or Basalt, which forms a nearly perpendicular cliff, about 120 feet in height, stretching into the sea, and dipping and diminishing in height in that direction. The Sandstones and Shale, in contact with the Basalt, are altered and affected in a similar way to that which usually takes place from the influence of Whin Dykes.

The mineralogical character of the Basalt, corresponds with that of the Whin Sill of Aldston and Teesdale; consisting of Felspar and Hornblende, and, where exposed to the sea, it assumes an apparently columnar appearance.

This mass of Basalt, diminishing in height from the south face, then forms a platform of rocks, varying from 12 to 20 feet in height, stretching along the coast for about two miles, dipping into the sea and presenting a rugged escarpment to the west, the line of direction being N. 21 E. At the north extremity, the Basalt again forms a high mount, on which the ruins of Dunstanburgh Castle stand. It here rests upon thin beds of gritty Sandstone, Plate, and Shale, which lie upon a thick bed of black Limestone much contorted, and every way resembling the thick bed near Howick, at the southern point of the Basalt. If these two beds of Limestone are identical, we must suppose that the Slip Dykes near Howick have elevated the strata on the north side, so as to throw in the Basalt and accompanying Limestones, as shewn in the Section No. 1, Plate XXVII.

From Dunstanburgh, underlying the Basalt, we find a series of low

grit rocks, very flat and undulatory, and in most places covered at high water.

At Bent Hall, about half a mile south of Beadnel, a thick bed of very hard yellow Limestone puts in, stretching out of a small bay about half a mile into the sea, rising north 7°, line of direction N. 80 E. The north face of this bed is about 30 feet thick, overlying Shiver 10 feet thick. These are succeeded by numerous beds of Limestone, Sandstone, and Shale; alternating as exhibited in Section, Plate XXVI. These strata constitute the great central deposit of Limestone; the following being an enumeration of the different beds.

	Feet.
Yellow Limestone (as above), ...	30
Shiver, or Bituminous Shale, ...	10
Yellow Limestone, ...	15
Alternating beds of very coarse Gritstone and Hazel, ...	30
Beds of soft Plate, ...	8
Bed, or series of layers of very hard black Limestone, containing Shells, ...	35
Yellow Limestone, ...	8
Coarse Hazle, gritty at top, ...	20
Black Plate, or Shale, ...	—

A Whin or Basaltic Dyke, here passes through the beds, at right angles to the line of stratification, varying in width from 25 to 30 feet, course S. 66½ E., dip N. 82°. The inclination of the beds being 8° S., direction N. 85 E. This Dyke does not displace the parallelism of the beds, but produces the same effect upon the Shale, &c. as similar Basaltic Dykes.—For a more particular description of this Dyke see *Geological Transactions*, vol. iv. part 2.

	Feet.
Black Limestone, ...	8
Coal, ...	½
Black Shiver, ...	20 to 30
Various beds of Slaty and compact Hazles, ...	40
Black Limestone, ...	4
Bed of Coal, ...	—
Black Plate, ...	5

	Feet.
Slaty micaceous Sandstone, quarried for Slates, ...	—
Black Dent, full of Cockle Shells, ...	4
Limestone, ...	4
Black Shale, ...	5
Shelly Limestone, used for Lime, ...	8
Thin bed of Coal, ...	—
Hard Sandstone, ...	20
Black Shiver, or Bituminous Shale, ...	5
Limestone, ...	4
Seam of Coal 2ft. 4in. workable, thickens to the west, but the general thickness is 30 inches.	
Sandstone, ...	30 or 40
Blue Shiver, ...	4
Sandstone, ...	5
Shiver, ...	4
Hard Grit Rock, ...	15
Shivery Shale, ...	4
Reddish Grey Limestone, ...	4
Shiver, ...	4
Hard Sandstone, ...	6
Plate, ...	4
Various beds of Reddish Sandstone, ...	50 to 60
Shiver, or Plate, ...	10
Hard Shelly Limestone, ...	6
Bed of Coal and Shale, ...	1
Plate Beds, ...	50 to 60
Shelly Limestone, ...	6 to 8
Hard reddish Sandstone rock, stretching along the coast for about a quarter of a mile, the inclination of which gradually alters, and finally becomes quite flat, probably the effect of some Slip Dykes.	

After passing a flat sandy beach of about a quarter of a mile, we find a series of beds of Sandstone, Shale, and Limestone, apparently part of the preceding, thrown down by the Slip Dykes previously noticed, viz.:—

	Feet.
Sandstone, ...	4
Hard Limestone, ...	5

	Feet.
Slaty Sandstone and beds of Plate, ...	20
Thin bed of Shelly Limestone, ...	—
Blue Limestone (quarried), ...	10 to 15
Clayey Parting, ...	2
Blue Limestone, ...	13
Plate, ...	4
Slaty, or Micaceous Sandstone, ...	20
Hard yellow Limestone, ...	5
Black Shivery Plate, ...	10
Thick bed of red gritty Sandstone, with alternating beds of Plate, ...	40 to 50
Coal and Shale, ...	4

From Beadnel the general rise of the beds is north, except where disturbed by the occurrence of Slip Dykes; but here a great change takes place; a bed of very coarse Red Sandstone puts in, underlying the preceding enumerated beds, which at first rises north, then gradually becomes more flat, and ultimately dips north about 1 in 12, towards the pier at North Sunderland.

This bed apparently stretches across the harbour, where some great Slip Dykes again occur; the beds where exposed, exhibiting a contrary dip to those from Beadnel, presenting the faces to the south, and dipping rapidly north.

This inclination of the beds continues, until the Whin or Basalt is again exposed, forming a ridge of low and flat rocks, covered at high water. That it is a bed of Basalt, occupying a position in, or about, the same part of the series, as the Whin of Dunstanburgh, is shewn by the beds of Limestone, which, from Beadnel, rise up from underneath the Basalt, taking a contrary inclination at Sunderland, and again dipping underneath this bed of Basalt.

After an interval of sandy beach of about half a mile, we reach Bamburgh, where we find the Basalt forming a high mount, on which the castle stands. The Basalt is here of great thickness, and presents on the north side an escarpment near 100 feet high. It rests upon a bed of Sandstone, which is much contorted, and affected by contact with the Basalt.

The Fern Islands, which lie nearly east from this place, are entirely composed of Basalt; and as the Basaltic rocks at Bamburgh dip in that direction, the Basalt of these islands is probably a continuation of the same bed. The Whin of Bamburgh extends north into the bay of Budle, where it has been extensively quarried. It also stretches westward to Belford, &c. which will be noticed hereafter. From Budle Bay, to beyond Holy Island, a flat sandy beach occurs; but the Basalt again appears at Holy Island, which is probably the termination to the north, the rise in the beds finally throwing it out at that locality.

Passing Holy Island, we again meet with the Limestones which underlie the Basalt. The first of these is a black Limestone, dipping N. W. at an angle of 35°; upon this lie some thick beds of Red Gritty Sandstone, which gradually flatten northward, apparently shewing the contrary dip of the Limestone to have been occasioned by a Dyke.

The beds then take a determined and regular rise to the north, presenting a series of beds of Limestone, Sandstone, and Shale rising out from underneath each other, and terminated by thick beds of Red Sandstone rocks stretching across the mouth of the Tweed.

The Section, Plate XXVI. though exhibiting a pretty accurate representation, of the order of superposition of these rocks, is not quite perspectively correct. The beds, which about half a mile south of Spital rise N.W., the line of direction being N.E., when opposite Major Johnson's house, gradually change their direction, until the line of bearing is north, and the dip almost due east into the sea. The lower beds of Red Sandstone, underlying the Limestone beds, therefore stretch across the estuary, and are found on the north side of Berwick Pier.

Tracing the series, from a thick bed of black Limestone, shewn in the Section; we find that rock overlying first a series of beds of Limestone and Grit rocks, then a very thick bed of Red Sandstone, under which lies a bed of Coal; below this are thick beds of Shivery Sandstone and Plate, overlying a bed of blue Limestone 8 to 10 feet thick, followed by a thick bed of compact Red Sandstone, at least 40 feet thick, resting on alternating beds of Sandstone, Shale, and thin beds of Coal; below these is a bed of workable Coal, reposing upon a series

of beds of Red and White Sandstone. The lower beds of these Red Sandstone rocks rise out to the west, from underneath the Coal and Limestones, at the mouth, and on the south bank of the Tweed, and gradually flatten westward;—they are extensively quarried at Tweedmouth. Below this, is a continuation of similar beds of Red and variegated Sandstone, and Shale, with occasional thin beds of Limestone, which form the predominent rocks up the vale of the Tweed, for a considerable distance from the mouth of that river. But as we shall have occasion to refer to that part of the district hereafter, I shall, for the present, pass them over, referring the reader to Mr. Winch and Mr. Witham's Papers, in *Trans. Nat. History Society*, vol. i. part 2, for a more particular description of these rocks.

The seams of Coal, worked in this district (*see* Mr. Winch's Paper, *Trans. Nat. History Society*, vol. i. p. 129), eight in number, occur near the bottom of the above series of Sandstone, Limestone, and Shale, and rest upon, and immediately above, the Red Sandstone of the Tweed. And as these rocks side out from underneath the Basalt, at Bamburgh, in every way corresponding with the beds of Limestone, &c., at Beadnel and Sunderland, which may be traced rising out from underneath the Basalt of Dunstanburgh, and the superior Grit rocks south of Howick; little doubt can exist, from an examination of the coast Section alone, of the Geological position of these Seams of Coal, and their accompanying beds of Red Sandstone; that they occupy a position in the lowest of the series of the Carboniferous Limestone formation, and below the great central deposit of Limestone.

The two gentlemen previously named, having, in their examination of the rocks of the Tweed, given particular descriptions of the Mineralogical character of these rocks, it is rendered unnecessary for me to repeat any further description in this paper, more than to state, that the Limestones exhibit all the characters, and contain the same organic remains as the Mountain Limestones. The Red Sandstone is essentially different in mineralogical character, though probably not far distant in geological position from the Old Red Sandstone. The object of this part of the paper being, however, more particularly to trace the position

of the various beds throughout the coast district, I shall proceed to take a rapid glance at, the probable succession of those beds, exhibited along this line of Section.

At the mouth of the Tyne, the regular Coal Measures are found underlying the cap of the Magnesian Limestone, at Tynemouth. In general, the Coal and softer beds of Shale, &c. not having withstood the action of the sea, are all denuded and covered with sand; but wherever the rocks have withstood the waves, we find, from the Tyne to the Coquet, those rocks are all referable to the regular Coal Measures. The workings of the different Coal Pits, and the various trials for Coal along this line, might also be adduced in corroboration of this opinion. How far beyond the Coquet, or if so far down in the series of these Measures, workable beds of Coal may exist, cannot, from an examination of the coast strata, be determined; but when we reach Alemouth we are certain of having passed the boundary of the Coal formation.

A series of Gritty Sandstones, with their accompanying Shales then occur, underlying the Coal Measures, which agree in character, as well as in position, with the "Millstone Grit," which reaches to near Howick. Messrs. Conybeare and Phillips terminate this class at the second or third Limestone Bed. If we adopt this classification, the northern extremity of this suite of rocks would therefore be about Boulmer Point.

We then find thick beds of Limestone rising from underneath the preceding Grit Rocks, corresponding with what is called by Conybeare and Phillips, "the great central deposit of Limestone." Passing the mass of Basalt between Howick and Dunstanburgh, which appears to be identical with the Whin Sill of the Lead Mine district, we have ten or eleven beds of Limestone bassetting out to the north, resting on, and terminated by a thick bed of Red Ferruginous Sandstone, at Sunderland, which, though a considerable way down in the series, does not appear so low as the Red Sandstones at the mouth of the Tweed. North of Sunderland, the beds are thrown down, and taking a contrary dip, the Basalt is again found at Bamburgh. From this place the strata rise north, and we again pass over the great central beds of Limestone, which are terminated by, and rest on, the thick beds of Red Sandstone,

which form the great deposit of those rocks in Berwickshire and the vale of the Tweed; and which, as before stated, have been mistaken for the New Red Sandstone.

This Red Sandstone, with occasional beds of Limestone, stretches north and west into Scotland, where it joins and reposes against the Grauwacke hills.—*See* Witham. *Trans. Nat. Hist. Society*, vol. i., p. 179.

We see, therefore, that by extending the Section of the coast to the Grauwacke hills of Scotland, we find exposed the whole series of the medial order of Conybeare and Phillips, with these two peculiarities: —1. That several beds of workable Coal exist in, and below, the great central deposit of Limestone; and 2. That thick beds of Red Ferruginous Sandstone, distinct in mineralogical character from the Old Red Sandstone, occur below these great central beds of Limestone, and underlying the Coal beds.

Deferring for the present any further remarks on the position of these rocks, I shall now endeavour to trace the basset of the various beds from east to west, commencing at the same point as in Section, Plate XXVI., or at the mouth of the Tyne, and stretching west to the New Red Sandstone district of Carlisle.

In all the Geological Maps which I have seen, the north-western limits of the Coal Measures are laid down as follows; viz.—From the mouth of the Coquet to the north-west of Belsay, Stamfordham, Harlow Hill, Newton, and Bywell; the extreme western limit being Hedley Fell. The regular Coal Measures do not, however, in the one case, reach so far to the north-west as these localities; the first Limestone beds, near the bottom of the "Millstone Grit," cropping out to the south of these places, whilst, on the contrary, I shall endeavour to shew that to the west the lower beds of the Coal Measures stretch for several miles beyond Hedley Fell.

From the mouth of the Tyne, we find the Coal Measures dipping west to Percy Main and Wallsend; they then take a rise westward, until the High Main Coal, which, at Wallsend, is above 100 fathoms from the surface, crops out upon Newcastle Town Moor. Following the

vale of the Tyne we find (except where affected by Slip Dykes) the beds pursuing a regular rise to the west, the lower beds successively cropping out on the banks of the river; and when we get beyond Prudhoe, we reach in the vale, the lowest beds in the series. The full rise of the strata is not however in the direct course of the Tyne, but north-west; and as hills of considerable height occur on the south bank of the river, the Coal beds stretch much further to the west along this ridge of hills, and we consequently find workable beds on Hedley Fell.

From this place a series of Slip Dykes, having a very considerable throw to the north, stretches away westward by Stublick, Coanwood, Hartley Burn, and Midgeholme to Tindal Fell. The course of these Dykes is here interrupted by several cross slips, and they are made to diverge south-west towards Croglin Fell; though there is reason to suppose that a continuation of the Main Dyke extends to the western escarpment of the Mountain Limestone between Talkin and Castle Carrick.

The throw of these Dykes being very considerable to the north, producing such a depression of the strata on the dip side, and their course being along a ridge of hills which gradually increases in elevation westward, we find on several of the eminences in different parts of their course, detached portions of the lower beds of the regular Coal Measures thrown in, considerably beyond the western verge of the limits of the Coal-field.

No. 2, Plate XXVII., exhibits a section of these detached Coal-fields, along the dip or north side of the line of these Dykes. The first of these is Stublick, about 5 miles south-west of Hexham; it extends for about 4 or 5 miles along the dip side of the Dykes, from east of Spital Shield, through Low and High Stublick, until it is cut off by the denudation of the vale of the west Allen rivulet. In this as well as in the other of these Coal-fields, the strata on the north side of the slip dip towards the Dykes, which indeed is almost the universal concomitant of Slip Dykes on the low or depressed side. The depth of the Coal-beds from the surface at the Dykes is not great, and the rise of the strata from the slip to the north causes the Coal to reach the surface within a few hundred

yards from the Dykes. In this Coal-field the distance which even the lowest Coal-beds extend from the Dykes does not exceed 400 yards; except when kept in by the accidental occurrence of branch slips, or casual elevation of surface. These patches of Coal are, as may be expected, considerably disturbed and affected by cross slips, branching out from the Main Dykes; and it is, therefore, difficult to identify the different beds with each other. The following beds have, however, been cut through in this district.

	Fa.	*Ft.*	*In.*
1. Coal, inferior in quality,	0	1	9
Strata of Sandstone, and Shale,	10	0	0
2. Yard Coal,	0	2	8
Sandstone and Shale,	4	3	0
3. Three-quarter Coal,	0	2	8
Sandstone and Shale,	4	0	0
4. Main Coal,	0	3	8
Sandstone and Shale,	7	0	0
5. Coal, from 13 inches to	0	1	8
Sandstone and Shale,	4	3	0
6. Little Coal,	0	1	10
Sandstone and Shale,	3	3	0
7. Stone Coal,	0	1	8
	36	0	11

The quality of these Coal-beds resembles those of the lower beds of the regular Coal Measures, one seam in particular, the Yard Coal, is of similar quality to one of the Wylam seams, producing Coke suitable for reducing the lead ores; a quality which none of the beds in this district, except those belonging to the regular Coal Measures, possess.

The real position of this Coal-field in the series is proved by the absence of all Limestone beds above the Coal; and, as will be shewn hereafter, by the occurrence of thick beds of gritty Sandstone, resembling Millstone Grit, underlying the Coal, and resting on beds of Limestone, which will be traced as belonging to the first beds of the mountain series.

Beyond the vale of the West Allen, these seams are again found upon

the high grounds of Plainmellor, Kingswood, and Coanwood: they here occur in more detached portions, owing to the form of the hills; but the beds are thicker, and approach more nearly in character to those of the next basin, which I shall now proceed to describe.

On the west side of the vale of the South Tyne, a little above Featherston Castle, a narrow tract of flat table land occurs, stretching westward at the base of Byers, Halton Lee, and Tindal Fells. The line of Dykes passes through these fells, leaving this plain on the north or dip side of the slip. Crossing the denudation of the vale, we again find the lower beds of the Coal Measures lying against the north side of these fells, and on the dip side of the line of Dykes. The beds of Coal here, are of considerable thickness, and are extensively worked at Hartley Burn and Midgeholme. The depth of the lower beds from the surface, contiguous to the Dykes, is here also much greater than at the other basins; and the surface of the ground being likewise favourable, the superficial extent of Coal is greater; the extent being from east to west above two miles, and the breadth probably one mile.

The following is a Section of the strata at Midgeholme, the property of the Earl of Carlisle, with the accompanying beds of Coal:—

	Fa.	*Ft.*	*In.*	*Fa.*	*Ft.*	*In.*
Sandstone, ...				9	0	0
	Fa.	*Ft.*	*In.*			
1. Upper, or Craignook Coal, ...	0	4	6			
Metal Stone and Plate, ...	0	2	3			
Lower Craignook Coal, ...	0	4	0			
				1	4	9
Plate or Shale, ...	0	2	6			
Sandstone, ...	5	3	0			
Grey Metal Stone, ...	1	0	0			
Sandstone, ...	3	3	0			
				10	2	6
2. Coal, Dobson's Three-quarter Coal, ...				0	2	3
Sandstone and Shale, alternating, ...				12	0	0
3. Coal, Well Syke Seam, ...				0	5	3
Thill, ...	0	0	1½			
Carried forward, ...	0	0	1½	34	2	9

			Fa.	*Ft.*	*In.*	*Fa.*	*Ft.*	*In.*
	Brought forward, ...		0	0	1½	34	2	9
	Hard White Sandstone, ...		2	3	0			
	Black Plate, ...		3	3	0			
	Shale, ...		2	3	0			
	Grey Beds, ...		5	1	0			
	Plate, ...		3	3	0			
						17	1	1½
4.	Coal, Midgeholme Seam, ...					0	5	0
	Soft Thill, ...					0	0	6
						53	3	4½

These beds of Coal are of good quality, particularly the Midgeholme Seam; being Bituminous, or Coking, with beds of Clay Ironstone in the strata between the seams. As remarked with respect to the other detached basins, this one is characterised by the absence of beds of Limestone above the Coal, and by corresponding strata of Grit and Limestones underlying the Measures; which, together with the thickness of the seams of Coal, and their similarity to the lower beds of the regular Coal Measures, prove their position in the series.

It is somewhat singular that so narrow a strip, or tongue, of the Coal Measures, should stretch to such a distance into the midst of the Mountain Limestone; for in no place does it exceed a mile in breadth, one-half being probably the average width, and that interrupted and cut off by all the ravines which cross the line; while its length, from the great body of the Coal Measures at Hedley Fell, is above 27 miles. This is occasioned, as before explained, by the depression of the strata on the north, or dip side of these Dykes, along the whole of their course. The extent of the throw will, no doubt, vary in different parts; but we find the Millstone Grit, and upper beds of the Limestone, successively crop out to the west, on the south or rise side of the Dykes.

Throughout a great part of the course of these Dykes, as far west as Stublick, they are common Slip Dykes; but west of Whitfield they are not only of that kind, but are accompanied by a Basaltic Dyke; and at

Midgeholme and Tindal Fell the Coal-beds are found cut off by a mass of Whin. This is probably occasioned by a Whin Dyke intersecting the line of the Slip Dykes, and then following their direction; as we find a Whin Dyke, which occurs near St. Oswald's Church above Chollerford, stretches across the South Tyne near the chain bridge, and passing Wharmley, proceeds in a direction towards Whitfield, where a Basaltic Dyke is seen crossing the West Allen. Diverging a little from this course, a Basaltic Dyke crosses the South Tyne near Harper Tower, following the line of the Slip Dykes.

The Midgeholme Coal Basin is the western extremity of this narrow slip of Coal Measures. Proceeding westward along the line of the Dykes, we find the strata on the north side rising rapidly from the Coal-field of Midgeholme, or from the boundary of the two counties; and in a very short distance on the east side of Tindal Fell, we pass the Grit Rocks rising out from underneath the Coal Measures, and meet with the first Limestones on Tindal Fell.

The line of Dykes here diverges considerably to the south-west, and the strata become more flat, and take a gradual rise west, or rather towards the south-west; stretching away towards the escarpment rising above the plain of Red Sandstone, where we find the beds of Lime-stone bassetting out.

As above stated, at Tindal Fell we find the upper Limestones, rising from below the Coal Measures. Accompanying these, we find a work-able bed of Coal, which forms the Coal works of Lord Carlisle, on the north brow of that fell. The Coal here consists of one workable bed, about four feet thick, lying underneath a bed of Limestone, from which it is separated by about forty feet of Sandstone and Shale. From the alteration of the dip of the strata, this Coal-bed, besides stretching away north-eastward, as will be noticed hereafter, widens out westward; and is again, after passing a series of Slip Dykes on the west side of Tindal Fell, found at Talkin.

At this place the determined direction of the strata is north and south nearly, rise west about 1 in 11 or 12. This bed of Coal consequently

rises west from Talkin towards the brow of the escarpment, from whence it stretches north, until it is cut off by a rise Dyke, and south into Geltsdale, where the same bed of Coal is worked.

The following is the sinking at the Blackside Pit, Talkin Colliery :—

	Fa.	*Ft.*	*In.*
Soil, Clay, &c.	2	0	0
Plate and Shale, ...	3	0	0
Strong Freestone, ...	2	4	0
Plate and Shale, ...	1	0	0
Freestone, ...	8	2	4
Plate and Shale, ...	3	3	7
Limestone, ...	3	5	0
Plate and strong Shale, ...	1	4	0
Freestone, ...	3	0	0
Strong grey Plate, ...	2	3	0
Coal, ...	0	3	3
	32	1	2

Along the brow of the escarpment, rising above the Red Sandstone, we find the lower beds of Limestone crop out from underneath the preceding strata and Coal-bed. The face of the escarpment ranging southwest, and the line of direction of the strata being south, as we proceed southward along the line, we get lower down in the series, or find the lower beds regularly rising to the surface :—viz.—first, the Limestones above the Basalt; then the Basalt; and, lastly, at Croglin (the southern extremity of our observations), the beds of Limestone below the Basalt, successively cropping out on the brow of the escarpment.

It would be extremely difficult to obtain an uninterrupted Section from the preceding Coal-bed to that worked at Croglin; the following is, however, a Section of strata lying below the Talkin Coal, exhibited at Croglin Fell.

	Fa.	*Ft.*	*In.*
Limestone, ...	7	0	0
Sandstone, ...	3	0	0
Carried forward, ...	10	0	0

	Fa.	Ft.	In.
Brought forward, ...	10	0	0
Plate, ...	3	3	0
Yellow Limestone, ...	5	0	0
Coarse gritty Sandstone, ...	2	0	0
Plate, ...	1	3	0
Coal, worked at Croglin for burning Lime, ...	0	1	3
Coarse gritty Red Sandstone, ...	3	0	0
Plate, ...	2	3	0
Black Limestone, ...	0	5	0
Sandstone, ...	5	0	0
Plate and Limestone, ...	3	3	0
Whin or Basalt, ...	3	0	0
Black Limestone, ...	6	4	0
Freestone, ...	1	3	0
Limestone, ...	–	–	–
	48	1	3

The escarpment here is of considerable height, but the debris prevents the beds from being traced lower down, or their junction with the Red Sandstone being examined.

We thus see that the two lines of Section Nos. 1 and 2, Plate XXVII., though at right angles to each other, terminate nearly in the same part of the series. The strata in the Section No. 1 being exposed on the sea shore, enables the observer to trace the connection of the Limestones with the Red Sandstone Rocks very accurately; while the debris along the base of the escarpment above the plain of Carlisle prevents such an examination from being made; for in no one place along the whole range of basset, from Croglin Fell to the Irthing, could the junction of the Limestone beds with the Red Sandstone be distinctly examined.

No doubt, perhaps, exists, that the Red Sandstone of Carlisle is the newer Red Sandstone, and probably the great similarity, not only of mineralogical character, but apparently of position also, between this Sandstone and that of the Tweed, may have occasioned the mistake that they are parallel formations, and caused them to be coloured as such in the Geological Maps.

I shall now endeavour to corroborate the preceding assumption of the extent of the lower beds of the Coal Measures to the west, and the position of the Red Sandstone of the Tweed, by tracing some of the most prominent strata through the district intervening between the two lines of Section.

It will be observed, that in the Alston Moor district, immediately below the "Little Limestone," and between it and the "Great Limestone," there occur traces and indications of Coal, called the High and Low Coal Sills. The position of these Coal Sills is, therefore, below the second bed of Limestone in the series. Under the first bed of Limestone there is also found a thin bed of Coal. These Coal Sills, which in Alston Moor exhibit only traces of Coal, on the north side of the line of Dykes produce workable beds of Coal, especially those which lie below the second bed of Limestone. The working of the different Coal Pits, which have been sunk to this Coal, will enable us to trace these Coal Sills and their accompanying beds of Limestone through the district, which I shall endeavour to do from west to east.

In Forster's Section of the Alston Moor district, the Great Limestone lies about 22 fathoms below the Little Limestone and Coal Sills; this distance, however, varies much, as will be seen by a reference to Sections in different parts of the same district. A bed of Limestone, agreeing in character with the Great Limestone, is quarried at Clowsgill, near Talkin; 26 fathoms above this lies the bed of Limestone enumerated in the Talkin Section, having a Coal seam 40 feet below it. This Coal bed, which is that worked, as before noticed, at Tindal Fell, Talkin, and Geltsdale, I consider belonging to these Coal Sills, having a bed of Limestone agreeing with the Little Limestone above it, and a thick bed of Limestone below, agreeing with the Great Limestone. The position of this Coal and Limestone, rising from underneath the Grit Rocks and Coal Measures of Midgeholme, corroborates this assumption.

Proceeding eastward from Talkin, we find a seam of Coal worked at Blenkinsopp, having similar beds of Limestones above and below, which, from the direction of the strata, leaves little doubt of being identical with that of Talkin. The thickness of the seam is here 3½

feet. This bed of Coal may be traced eastward to Haltwhistle, Haydon Bridge, and Fourstones; at which latter place it is worked by the Greenwich Hospital. To the east of this, for some distance, the strata are much dislocated by Slip Dykes; but the same bed of Coal is again worked on the east side of the North Tyne at Acomb, Wall Fell, and Fallowfield.

The following is a Section at the latter place, from a bed of Limestone called the Little Limestone.

			Fa.	*Ft.*	*In.*
Little Limestone, ...			4	2	7
Plate, ...			1	5	0
	Ft.	*In.*			
Coal, good, ...	3	0			
band, ...	0	9			
inferior, ...	1	8			
			0	5	5
Plate and grey Beds, ...			1	1	0
Hazel and grey Beds, ...			14	5	7
Plate, ...			14	5	8
Great Limestone, ...			10	0	0
			48	1	3

The strata here dip south-west, and we find only one bed of Limestone above the Little Limestone. Tracing the strata to the dip, we reach the mass of Sandstones equivalent to the Millstone Grit, bassetting out on the north face of the hills above Hexham, and overlying the preceding Limestones; and still further beyond this, to the south-west, we reach the regular Coal Measures at Stublick, underlaid by the Sandstone beds abovenamed, as shewn in Section No. 3, Plate XXVII.

For a considerable distance east of Wall Fell we do not find any Coal beds of consequence worked. The first which occurs corresponding with that of Wall Fell is worked at Ingoe and Kirkheaton. The seam of Coal is here about four feet thick, and above it lie two beds of Limestone, separated by nine feet of black Metal; and below the Coal lies a thick bed of Limestone, which is quarried at Kirkheaton. It is necessary here to remark, that although these Limestones and Coal

agree in position with those of Fallowfield and Wall Fell (one bed of Limestone occurring at Belsay and Stamfordham, between them and the Grit Rocks), yet the Limestone above the Coal is in two beds. At Fallowfield, however, the Little Limestone is divided by a thin parting into two distinct layers, or, as the miners term it, into "two posts;" probably these two layers may, to the east, be divided by the interposition of a bed of Plate, which gradually increasing in thickness, ultimately forms two distinct beds of Limestone.

Proceeding north-east from Kirkheaton, the same bed of Coal may be traced to Capheaton and Wallington. At Brinkburn, on the Coquet, a seam of Coal is worked nearly three feet thick, lying below a bed of Limestone, and underneath which lie some thick beds of Limestone. Following this direction, we come to Newton and Shilbottle, which appears to be the same bed of Coal (for a Section of which see *Geo. Trans.* vol. i., part iv.). From this they range north-east, where the denudation of the Aln cuts them out; but we find the accompanying Limestones running into the sea to the south of Howick, as exhibited in the coast Section

Along the whole course of this line we have only one or two beds of Limestone to the south, which, being in the direction of the full dip, shew that they overlie the preceding Coal bed and Limestones. These beds of Limestone have, in some places, workable beds of Coal lying underneath them, as near Hexham Bridge, at Shildon near Newton Hall, Stamfordham, Belsay, &c.

Tracing these strata to the south, we find thick beds of coarse gritty Sandstone, overlying the Limestone; as at Unthank, above Haydon Bridge, and along the south-west bank of the river Tyne, to and below Hexham; then, crossing the river, we meet with them again at Bearl, Horsley, Harlow Hill, Berwick Hill, Saltwick, Helm-on-the-Hill, &c. &c., which are identical with the Millstone Grit, and which dip throughout the whole extent of that range underneath the Coal Measures.

Although the position of these thick beds of Sandstone, with respect to the other parts of the series, agrees accurately with the Millstone Grit of Derbyshire, &c., yet it is necessary to remark, that on the north side

of this line of Dykes, their mineralogical character scarcely entitles them to a distinct appellation. At the bottom of the Coal Measures there certainly occur thick beds of Gritty Sandstone, containing imbedded fragments of large and angular Quartz; but these grits are not more coarse, and they are not otherwise more particularly distinguishable, than several of the Sandstones belonging to the Lead Measures, and even not more than some of those of the regular Coal Measures. If these beds are, therefore, entitled in this district to a distinctive name, as part of a general formation, they must be here characterised as thick beds of coarse Gritty Sandstone, almost entirely destitute of mineral products, lying between the bottom of the Coal Measures and the first Limestones of the Carboniferous series. It is rather difficult to say where the lower limit of this formation should be fixed—perhaps, most properly, at the first bed of Limestone. It certainly should not be below the seam of Coal of Talkin, Shilbottle, &c., as the next Limestone below is that, which, according to Westgarth Forster, "has produced as much Lead Ore as all the other strata throughout the whole Section." I have, therefore, coloured the Millstone Grit as terminating at the second bed of Limestone, or along the range of the bed of Coal previously traced throughout the district; if it is made to terminate at the first bed of Limestone, the line would be about the middle of that range.

On examining the range of the first Limestones and the superimposed Gritty Sandstones, it appears that they dip not only underneath the regular Coal Measures, where the great body of that deposit exists, but it will be seen that these beds also stretch away westward and dip under these detached Coal Basins, thus proving the real position of the latter in the series. *See* Plate XXVII.

I shall now endeavour to trace some of the lower beds of the series, or the great central beds of Limestone, with reference more particularly to the position of the thick and numerous seams of Coal occurring near the mouth of the Tweed.

The bed of Coal worked at Geltsdale, &c., has been traced eastward throughout the district to Shilbottle; this bed of Coal is stated to lie above the great Limestone, and, therefore, the range of the one will exhibit

pretty nearly the basset face of the other. In the Alston Moor district we find a series of seven beds of Limestone, alternating with Hazel and Plate, below the great Limestone, when we reach a bed of Basalt, called the "Whin Sill." I am aware, that by some, the apparently detached masses of Basalt, which cap several of the eminences in Northumberland, have been considered as overlying masses. On a more attentive examination, however, and particularly in reference to the connection of this Basalt with the beds previously traced, and also with the inferior Limestone beds, it will, I trust, appear, not only that the Basalt of the Lead Measures, commonly called the Whin Sill, ought to be considered as a stratum, keeping nearly a determinate place in the series, but that the whole of the apparently detached masses of Basalt, in the county (except those occurring in the shape of Whin Dykes), are attributable to this bed of Basalt.

The escarpment at Croglin exhibits four beds of Limestone above the Basalt, all of which are below the great Limestone. How many more there may be cannot be determined. Along the face of the hills, above the plain, the Basalt keeps nearly in the same position to Cumrew, when we lose it amongst the Slip Dykes near Talkin. Following the direction of the beds north-eastward, we find the Basalt again bassetting out near Temmon, and adjoining the turnpike-road between that place and Gap-shields. Crossing the vale of the Tippald, we again find it bassetting out on the east bank at Wall Town Crag. From thence to Walwick, it forms a series of bold and pointed eminences, nearly along the line of the Roman Wall; we then lose it amongst the debris on the west bank of the North Tyne; but, crossing the vale, find it again at Barresford, from whence it stretches away towards Bavington and Kirkwhelpington. From this place, for a considerable distance eastward, I have not had an opportunity of tracing it; but it probably keeps on the south side of the Simonside hills, and east of Rothbury, as we find, to the west of these localities, the Limestone beds, which in the other parts of its course underlie the Basalt. Further to the north east we find it skirting the east side of the moors above Alnwick, where it is quarried at Greenfield. Passing the denudation of the Aln it is exposed at Ratchiff

Crag, from whence it stretches away towards Howick, near which it passes into the sea, as exhibited in the Coast Section.

This line exhibits the basset face of the Basalt, dipping south east with the other strata. Throughout the whole of this course we find a few beds of Limestone between the Basalt and the Coal and Limestone previously traced. It is difficult to ascertain the precise number in any instance, but in several places four or five beds may be seen, especially along the north side of the vale of the South Tyne, above Haydon Bridge; also on both sides of the North Tyne, near Chollerford; and again from Kirkheaton westward. East of the Coquet, the beds of Limestone above the Basalt, and underlying the Coal, may also be traced; and the Coast Section will shew its position with respect to the upper strata, though the Slip Dykes, near Howick, prevent the precise number of beds above the Basalt from being ascertained.

Where the Basalt reaches the sea, the direction of the beds is nearly in the line of the coast, and hence we find the Basalt stretching along the coast for nearly two miles, until we reach Dunstanburgh, the north rise in the beds then throws it out, and the underlying beds of Limestone successively crop out along the coast. Again, however, at North Sunderland, the beds take a contrary dip, and although we cannot ascertain precisely, that the same number of beds, which, near Beadnel, rises up from underneath the Basalt, again dips down, yet, in a position, as nearly the same in the series as we might imagine, we again find the Basalt, near Bamburgh. The direction of the beds here being nearly east and west, the Basalt stretches away westward a considerable distance, into the country to Belford, &c. Here again, however, a change in the inclination of the beds takes place, the full rise being nearly west, and accordingly we find the Basalt forming a line of hills, stretching nearly north and south towards Haggerston, when the rise of the beds again verging round to the north, finally throws the Basalt out, and exhibits the central beds of Limestone rising from underneath.

That this Basalt is a bed, and not an overlying mass, is proved by beds of Limestone and Shale reposing upon it, in many of the localities

throughout its course, especially at Croglin, where, although it clearly occurs as a bed, with Limestone resting on it, yet in some places it has the appearance of having been injected between the beds, displacing, in several instances, the Limestone and Shale into detached masses. Along the range of hills, between Glenwhelt and Chollerford, its character as a bed may be seen; east of the North Tyne also, and particularly at Bavington, where in the Lead Mine it has been sunk through. It does not, however, occur in all this range as a single bed or stratum, but in several places, appears divided into two or three, with thin beds of Limestone or Sandstone intervening, as at Bavington, &c., and the coast section will shew its effects upon the strata at Howick. The great correspondence of the range of basset of the Basalt, with that of the upper beds of Limestone and Coal, shews that it keeps nearly the same position in the series; and it is somewhat remarkable, that at the two extremities of the range, at Croglin and Dunstanburgh, the Basalt reposes upon a bed of black Limestone of nearly the same character.

We come, now, to the great beds of Limestone, Shale, and Sandstone, which underlie the preceding strata: as previously noticed at Croglin, some of the beds of Limestone, below the Basalt, crop out on the face of the escarpment before we reach the plain of Red Sandstone; but here the Red Sandstone and debris, at the foot of the hills, lie against and cover a considerable portion of their base, so that the lower beds are not exposed. This is the case along the whole face of these hills to near Talkin. Here, as before observed, a change takes place in the direction of the beds, the full rise, which at Croglin is nearly west, now verges round to the north west. The eastern limit of the plain of the Red Sandstone, or western edge of the Mountain Limestone, stretches away north into Scotland, partly in the line of the rise of the strata; and as the plain of Sandstone is comparatively level, in following the western edge of the Limestone, we successively get lower down in the series in proceeding northward, and at the junction of the Liddle and Esk rivulets, we arrive at nearly the bottom of the Limestone beds. The western face of these beds now covers a considerable

extent of country, reaching from Talkin to the Grauwacke Hills of Eskdale, dipping under the Coal and upper Limestone beds at the former place, and reposing against the transition hills of the latter. Proceeding eastward, we find the upper beds of Limestone, Plate, and Hazels or Sandstone, below the Basalt, dipping on the south-east edge underneath that rock, as previously traced, and the lower beds of the series bounded by and reposing against the transition hills of Carter Fell, Cheviot, &c.

Section No. 3, Plate XXVII., will shew the position of the beds along the course of the North Tyne, to the Lewis Burn. I have not had an opportunity of correctly ascertaining the junction of the lower beds with the transition hills, and therefore have deferred, for the present, the continuation of that Section. The northern limit of the Mountain Limestone may, however, be traced eastward along the base of the Scotch and Cheviot Hills into the vale of the Tweed. The south-eastern edge of the beds dips underneath the Basalt along the whole extent of the range of that rock from Talkin to the sea at Dunstanburgh; when probably the protusion of the Cheviot Hills to the eastward throws the range of the edge of the Basalt and underlying beds a considerable distance into the sea, from whence they again recede, by a change in the dip of the strata, along the line of the Fern Islands and Bamborough.

The Basalt then trends westward, and we have the lower beds of Limestone, which are exposed along the line of the coast from Beadnel to Bamburgh, dipping underneath the Basaltic Hills along the ridge west and north from Belford, until the north rise of the strata throws the basset of the Basalt again eastward into the sea, and exposes the lower beds of the Limestone upon the coast near Scremerston.

The whole extent of the county eastward from the plain of New Red Sandstone of Carlisle, bounded on the south and east by the line of Basalt, and on the north by Scotland and the Cheviot Hills, to and beyond the vale of the Tweed, exhibits, therefore, the lower beds of the Mountain Limestone, dipping, with considerable undulations, south and east underneath the upper members of that series. Throughout this district these beds form in some places hills of considerable magnitude,

especially the beds of Limestone and Hazels or gritty Sandstones, and the Limestone beds are extremely undulatory. Except the seams of Coal, little of mineralogical interest has been discovered in this district; Lead Ore has been found in several places, but quite insignificant in comparison with the produce of the same extent of measures south of the line of Dykes of Section No. 2, Plate XXVIII.

The number and thickness of the beds of Coal increase, however, very materially north of this line. At the west extremity of the district, the first bed below the Whin is found east of Talkin, and again at Baron House near Gilsland, where it is between 4 and 5 feet thick. From this latter place it stretches away eastward, along the top of the moors for a considerable distance, rising north. It is again found at Scotch Coulthard, where it is worked, the direction of the beds being north-east, and rising north-west. A seam of Coal crosses the North Tyne near Otterstone Lee, which appears to be the same bed, and is worked on the east bank of that river at Kennel, where it is 5 feet thick, overlaid by a thick bed of Limestone. It is worthy of remark, that the Gilsland mineral water issues out of the strata near this bed of Coal; and that at Otterstone Lee, nearly in the same position with respect to the Coal, a mineral spring is found agreeing in character with that of Gilsland. If these two seams of Coal be identical, there are other thin beds of Coal between it and the Basalt, as Coal is worked near Bellingham and other places; but as the strata here are generally flat and undulatory, and much intersected by ravines, the same bed may be exposed in different parts, in the line of the full rise of the strata. Proceeding north-eastward from the North Tyne, it is supposed that the Kennel Coal stretches across the moors into the Coquet, as Coal seams are found in different places, and generally underneath a Limestone bed near the head of that river. In Rothbury forest, and again on the moors west of Alnwick, Coal is found in the Limestone beds underneath the Basalt. We find also thin beds of Coal at an inconsiderable depth below the Basalt, west of Belford, and near Haggerston.

The most considerable seams of Coal, however, occur below the great central beds of Limestone, and near the bottom of the series; and

generally where the strata are flat. Following the western edge of the Mountain Limestone, adjoining the Carlisle New Red Sandstone, when we reach the Esk and Liddle rivulets, we get near the bottom of the series, and there meet with thick beds of reddish brown Sandstone, with accompanying thin beds of Limestone, and two or three workable seams of Coal, which appear to correspond with the Red Sandstone beds of the Tweed, and which are overlaid by the central Limestone. Further east on the banks of the Lewis Burn, near the head of the North Tyne, we find two or three workable seams of Coal in a nearly similar position in the series, having the great beds of Limestone lying above the Coal. To the east of this, for a considerable distance, little Coal of any consequence has as yet been discovered (though this does not prove its non-existence); but, probably, the protrusion of the Grauwacke hills of the Cheviot, within the range of the lower beds of Limestone, by producing such a dislocation of the strata, may, in a great degree, affect the developement of the Coal beds; for it may be remarked, that in general we find the Coal beds increase, not only in extent but also in number and thickness, when the strata become flat. This part of the district requires, however, a more minute examination.

Passing the eastern edge of the Cheviot Hills, we find the central beds of Limestone dipping east underneath the Basaltic hills, west of Belford. On rounding, however, the north-eastern edge of the Cheviot, we find the strata take a more northerly rise; the upper beds of Limestone dipping south-eastward under the Basalt, and their basset face stretching away towards the sea south of Scremerston, where by the coast Section they are seen rising north. This rise of the strata, west along the face of the Basaltic hills, from Belford to near Lowick, and north and west along the line of the coast, throws out in succession the different beds of Limestone to the surface. The lower beds, however, as they recede from the influence of the Cheviot Hills, and probably become affected by the transition hills north of the Tweed, gradually flatten out and stretch away up the vale of the Tweed in the form of an elongated basin, the edges of which rise up against, and repose upon, the base of the transition hills of the Cheviot and Lammermuir. Lower down the Tweed

the influence of the latter hills appears to predominate, and the rise of the beds then ranges more towards the north. This position of the strata exposes, in the vale of the Tweed, the lowest beds of the Mountain Limestone series, having the great central beds of Limestone cropping out to the south and east of Ford, Barmoor, Ancroft, and Scremerston.

The lower beds which thus form the rocks in the upper part of the vale of the Tweed are, as previously noticed in explanation of the coast Section, thick beds of Red Ferruginous Sandstone, with occasional thin beds of Limestone, lying immediately underneath the great central beds of Limestone. Mr. Witham and Mr. Winch have, in the *Trans. Nat. History Society*, pp. 117—172, described more particularly the local position and mineralogical character of the beds of Sandstone in this part of the Tweed, rendering it unnecessary for me to give any more detailed account in this paper. Mr. Witham, especially, has succeeded in discovering and elucidating the existence and character of numerous Fossil Plants, imbedded in the Shale accompanying these Limestones, which are well worth the attention of the Geologist.

It is in the superior beds of this Red Sandstone and thin beds of Limestone, and underneath the great central beds of Limestone, that the numerous seams of Coal, forming the Scremerston and Gatherick Coal-field, exist,—a Section and description of which, by Mr. Fenwick, is given in vol. i., p. 129, *Trans. Nat. Hist. Society*. The Coal, though exhibiting the general properties of that found in the Mountain Limestone, is superior in quality to several of the thin beds found in other parts of this formation: but the quality differs essentially from that of the regular Coal Measures, in being more Carbonaceous, having a considerable residue of ashes, and not being sufficiently Bituminous to render it coking. Agreeably to the position of the underlying beds, these Coal seams rise rapidly from the coast westward, when they gradually become more flat, and assume a more southerly dip, cropping out to the surface on the east and southern banks of the rivers Till and Tweed; the upper beds being worked at Scremerston, and the lower at Shoreswood, Gatherick, Etal, and Ford.

A question naturally arises, why we do not, throughout the whole range from the west, along the base of the transition hills, find in the lower beds of the series such seams of Coal as those of Scremerston. The only beds which appear at all equivalent to those of Berwick, being the Coal found on the Esk, and near the head of the North Tyne. It must, however, be observed, that in no place throughout the whole extent of the range, do we find so extended a plain near the bottom of the series as that of the Tweed; and in few places do we descend so low down in the series, except close to the base of the transition hills, where we find the strata much broken or distorted, and the inclination often considerable.

That this expanding or flattening out of the strata, in the Mountain Limestone, has some effect upon the beds of Coal has been previously noticed, and may be proved by tracing some of the beds in their range eastward, where the strata become flat; Coal Sills, which, in the high and mountainous district of Alston Moor, exhibit only traces of Coal, furnish thick and workable beds in the comparatively flat and extended country to the eastward.

In conclusion, it appears, therefore, that the lower beds of the Mountain Limestone, in the north eastern parts of Northumberland, contain several beds of workable Coal, below the great central beds of Limestone, and that these Coal seams rest upon thick beds of Red Ferruginous Sandstone, distinct in character from the old Red Sandstone, but which they probably overlie; as in some parts of the base of the Grauwacke hills of the Cheviot and Scotland, we find conglomerates resembling the old Red Sandstone rising out from underneath the Mountain Limestone, and Ferruginous Sandstone.

LIST OF

PRESENTS AND PURCHASES.

PRESENTS.

QUADRUPEDS.

1829.	Wild Cat *(Felis Catus)*. Shot in the Highlands of Scotland.	G. C. Atkinson, Esq. Carr-hill.
	Dormouse *(Myoxus muscardinus)*. Taken in the woods, near Ebchester.	Mr. Askew, Whittonstall.
	Didelphis Lemurina, 2 specimens.	P. J. Selby, Esq. Twisel House.
	Wild Cat. Shot in the woods, near Wilmington, North Carolina.	Rev. J. Collinson.

BIRDS.

1829. September.	Stormy Petrel *(Procellaria pelagica)*. Shot on the Tyne, near Benwell Boat-house, during very fine weather in the month of October, 1829; its flight was very similar to that of the swallow, and it occasionally skimmed the water as swallows do.	G. C. Atkinson, Esq., Carr-hill.
November.	Hedge Sparrow *(Accentor modularis)*.	G. C. Atkinson, Esq. Carr-hill,
November.	White Owl *(Strix flammea)*.	Mr. Hepper, Close, House.
December.	Great Northern Diver *(Colymbus glacialis)*. Shot on a hog, near Embleton, Northumberland, Dec. 1829.	Mr. G. Davidson, Embleton.
December.	Common Thrush *(Turdus musicus)*; Scaup Duck *(Anas Marila)*.	Robert Losh, Esq. Jesmond.
1830. January.	Fieldfare *(Turdus pilaris)*. Shot near Newcastle.	Mr. J. T. Bell, Ewart, near Wooler.

Date.	*Donations.*	*Donors.*
1830. January.	Coal Titmouse *(Parus ater)*. Longtailed Ditto *(P. caudatus)*. Yellow Hammer *(Emberiza Citrinella)*. Magpie *(Corvus Pica)*. Chaffinch *(Fringilla cælebs)*, 4 specimens. Redwing *(Turdus Iliacus)*. Judcock *(Scolopax Gallinula)*. Greater Titmouse *(Parus major)*. Green Finch *(Loxia Chloris)*. Creeper *(Certhia famaliaris)*.	Ralph Carr, Esq. Dunston Hill.
	Common Heron *(Ardea cinerea)*.	Mr. James Turner, Morpeth.
	Iceland Gull *(Larus Islandicus)*, 2 specimens. Shot at Cullercoats.	Mr. G. Burnett, jun. Newcastle.
Jan. 21.	Goosander *(Mergus Merganser)*, male in the plumage of the female.	Miss Davidson, per Mr. Adamson.
Jan. 25.	Common Heron *(Ardea cinerea)*; Red-necked Grebe *(Colymbus rubricollis*, Lath.*)* Shot on the Coquet.	Dixon Dixon, Esq. Newcastle.
	Greater Black Backed Gull *(Larus marinus)*; Herring Gull *(Larus argentatus)*. Shot at Cullercoats.	Mr. John Hancock, Newcastle.
Jan. 27.	Sea Eagle *(Falco albicilla, jun,)*. Shot about a mile to the west of Morpeth, in Jan. 1830; it did not seem very wild, and there was no companion observed with it. *Dimensions.*—Breadth, 7 feet 2 inches; length, 2 feet 10½ inches; from the point of the bill to the wick of the mouth, 3 inches; to the brow, 2 inches; back claw, 1⅞ inches long; inner claw, 2 inches long; weight, 8lbs.	John Moore, Esq. Morpeth High House.
Jan. 30.	Young Kittiwake *(Larus Rissa)*. Shot at Cullercoats.	Mr. G. Burnett, jun. Newcastle.
	Short Horned Owl *(Strix brachyotos)*, male.	Ralph Carr, Esq.
February	Little Grebe *(Podiceps minor)*. Shot on the Coquet.	Dixon Dixon, Esq.
	Magpie *(Corvus Pica)*.	Cooper Abbs, Esq. Newcastle.
	Golden Eyed Duck *(Anas Clangula)*, young; Red-necked Grebe *(Podiceps subcristatus)*, young.	Mr. J. T. Bell, Ewart, near Wooler.
	Longtailed Duck *(Anas glacialis)*. Shot at Embleton.	Mr. G. Davidson, Embleton.
	Bald Coot *(Fulica atra)*	Mr. Joseph Burn, Cattraw, near Stannington.
	Guillemot *(Colymbus Troile)*, 2 specimens.	Mr. John Hancock, Newcastle.
	Goosander *(Mergus Merganser)*, a very fine specimen. Shot on the Coquet.	Thos. Smith, Esq. Togston.
	Scaup Duck *(Anas Marila)*, female.	Dixon Dixon, Esq.

Date.	*Donations.*	*Donors.*
1830. February	Scoter *(Anas nigra)*, male and female. Scaup Duck *(Anas Marila)*. Purre *(Tringa variabilis*, Tem.*)*. Common Thrush *(Turdus musicus)*. Common Snipe *(Scolopax Gallinago)*.	Mr. G. Davidson, Embleton.
	Yellow Bunting, 4 specimens. Green Grosbeak, 5 specimens. Chaffinch, 2 specimens. Sparrow, 2 specimens, Mountain Finch. Water Ouzel. Blackbird. Jay. Magpie. Missel Thrush. Fieldfare. In all 20 specimens.	Mr. Johnson, Haydon Bridge.
	Little Grebe *(Podiceps minor)*.	Mr. Proctor, Stannington.
	Bittern *(Ardea stellaris)*. Shot by Mr. Davidson, in the Bishop of Durham's plantations, near Bedlington, Northumberland.	Mr. Thos. Davison, Sedgefield, per Mr. W. Spencer.
	Fieldfare and Redwing.	Mr. Cooper Abbs.
	Common Gull *(Larus canus)*. Herring Gull *(Larus argentatus)*. Razor Bill *(Alca Torda)*. ScaupDuck *(Anas Marila)*. Wigeon *(Anas Penelope)*. Red-necked Grebe *(Podiceps rubricollis)*.	Wm. Orde, Esq. Nunnykirk.
	March Titmouse *(Parus palustris)*. Shot at Ewart.	Mr. J. T. Bell, Ewart, near Wooler.
	Longtailed Titmouse *(Parus caudatus)*; Missel Thrush *(Turdus viscivorus)*.	Ralph Carr, Esq. Dunston Hill.
	Judcock *(Scolopax Gallinula)*.	Mr. Geo. Wailes, Newcastle.
	Wild Swan *(Cygnus ferus)*, immature. Driven upon the coast of Durham during a storm.	W. Mills, Esq. Willington, Durham.
	White Owl and Bulfinch.	Dixon Dixon, Esq.
	Velvet Duck *(Anas fusca)*.	Mr. E. Backhouse, jun. Sunderland.
	Egyptian Goose *(Anas Egyptiaca)*, male and female. Shot at the Fern Islands, in March, 1830.	Mr. W. C. Hewitson, Percy Street.
April.	Razor Bill *(Alca Torda)*. Shot at Cullercoats.	Mr. Geo. Burnett. jun.
	Corncrake *(Rallus Crex)*.	Mr. Wm. Wilson, Newcastle.

Date.	*Donations.*	*Donors.*
April.	Corvus, supposed to be new to Britain. Shot at Blagdon, in Northumberland, and seems to be a non-descript species, the bill resembling more that of the Jackdaw than the Carrion Crow, to which, in other respects, it is somewhat similar; the space between the eye and root of the bill is, however, more destitute of feathers; the feathers under the bill extend considerably further toward the tip; the legs are stronger in proportion, the wings are of dark blackish brown, and the bird is altogether smaller than the Carrion Crow. The donor, who, from his occupation, has had this species frequently under his observation, remarks, that though frequently seen in pairs, he has never found their nest; that they do not associate with the common Crows, and that they are so tame as to permit a very near approach. He thinks them birds of passage. Communicated May, 29, 1830.	Mr. Anth. Strong, Gamekeeper.
1830. February	Blackbird, Chaffinch, and common Willow Wren.	Mr. Hepper, Close House.
	Goat Sucker *(Caprimulgus Europæus)*. Shot near Close House.	Mr. Hepper, Close House.
	Dunlin *(Tringa variabilis)*, 2 specimens. Shot at Prestwick Car, May, 1830.	Mr. Steph. Tueart, sen. Newcastle.
	Fifty-nine Birds' Skins, viz.:— Eider Duck *(Anas mollissima)*, 3 specimens. Redbreasted Merganser *(Mergus Serrator)*, female. Bubo africana, male. Falco Jackal, female, old. F. musicus, male. F. melanopterus, male. Corvus dauricus. Pterocles Tachypetes, male and female. Alauda magnirostris, male. Ptilonorynchus Smithii (New Holland). Lamprotornis. Rallus capensis, female. Pluvianus coronatus. Merops apiaster. Lamprotornis splendens (South Africa). Saxicola. Columba. Brachypus capensis, 2 specimens. Lamprotornis Nileus. Colius leuconotus. Merops. Picus. Fringilla Astrilda. Crex niger, female. Saxicola montium. Columba capensis, male. Mimeta viridis (New Holland). Turdus superciliaris, female. Parus africanus. Anthus capensis. Eurystomus orientalis.	P. J. Selby, Esq. Twisel House.

Date.	*Donations.*	*Donors.*
	Zosterops. Cuculus cinerascens (New Holland). Saxicola, 2 specimens. Alauda. Soriculus chrysocephalus, young male. Lamprotornis Morio. Turdus olivaceus. Coccothraustes. Saxicola, young. Saxicola. Alauda, female. Perdix afra. Otis Leucotis. Porphyrio Irio. Scopus mubretta. Eight others unnamed.	
	Twenty-eight Skins of Foreign Birds, viz.:— 1 Coracias. — Psittacus hæmatodus. Gracula religiosa. — Corvus cristatus. 1 Loxia. — 1 Lamprotornis. 2 Oriolus. — Sturnus Louisianus. 1 Lanius. — Oriolus Baltimore. 1 Totanus. — 1 Hirundo. 3 Picus. — 1 Charadrius. Merops apiaster. — 1 Bombycivora. Euristomus orientalis. — Seven undetermined.	Mr. Gould, Golden Square, London.
	Falco Tinnunculoides, male and female. Pterocles setarius, male and female. ———— arenarius. All from Spain.	Capt. Cook, Newton Hall.
	INSECTS.	
	Sixty-one species of Chinese Insects.	John Jobling, Esq.
	Twelve species of South American Insects.	D. Dixon, Esq.
	Fifty-nine species of New South Wales and South American Insects.	Mr. Taylor, Boldon.
	Twenty-nine species of Insects, from South and North America.	Mr. Empson, Newcastle.
	SHELLS.	
	Fourteen species from New South Wales and South America, viz.:— Trochus, nov. sp. — Siphonaria, nov. sp. Nerita, do. — Patella, do. Cerithium, do. — ———, do. Turbinella, do. — Ricinula Morio. Pleurotoma, do. — Galeolaria decumbens. Arca, do. — Balanus olivaceus. ——, do. — Chiton piceus.	Mr. Taylor, Boldon

Date.	*Donations.*		*Donors.*
	Thirty-one species of South American Shells, viz. :—		Joseph Fryer, Esq. Newcastle.
	Solen solidus.	Fissurella crassa.	
	Ampidesma solida.	——— peruviana.	
	Venus magna.	——— nov. sp.	
	Chama, nov. sp.	——— nov. sp.	
	Mytilus ovalis.	Crepidula peruviana.	
	——— magellanicus.	——— trochoides.	
	——— angulatus.	——— nov. sp.	
	——— nov. sp.	Bulimus peruvianus.	
	Orbicula lævis.	——— nov. sp.	
	Chiton aculeatus.	——— nov. sp.	
	——— olivaceus.	Auricula, do.	
	——— lineolatus.	Sigaretus concavus.	
	Siphonaria, nov. sp.	Monodonta, nov. sp.	
	——— do.	Concholepas peruvianus.	
	Fissurella picta.	Petricola, nov. sp.	
	Eight species from North America, viz. :—		John Adamson, Esq. Newcastle.
	Unio alatus.	Unio orbicularis.	
	—— prælongus.	—— undulatus.	
	—— Phaseolus.	—— crassus.	
	—— ellipticus.	Alasmadonta rugosa.	

ZOOPHYTES.

	Flustra truncata.	Sertularia pumila.	John Stark, Esq. Edinburgh.
	——— foliacea.	——— operculata.	
	——— carbasea.	——— spinosa.	
	Cellaria loriculata.	——— abietina.	
	——— Thuia.	——— lendigera.	
	Campanularia dichotoma.	Antennularia indivisa.	
	——— geniculata.	Plumularia falcata.	
	Sertularia cupressina.	Corallina officinalis.	
	——— muricata.		
	All from the Firth of Forth.		

PLANTS.

	One hundred and sixteen species of Plants from Australia, viz. :—		Mr. Taylor, Boldon.
	Stenochilus ovata.	Conospermum taxifolium.	
	Hibiscus spatulatus.	Boronia serrata.	
	Anigozanthus grandiflorus.	Driandra floribunda.	
	Acacia podalarifolia.	Boronia pinnata.	
	A. impressa.	B. paradoxa.	
	Tetratheca ericoides.	Banksea compar.	
	Pimelia decussata.	Schizea bifida.	
	Platylobium formosum.	100 other species not named.	
	Driandra armata.		
	Two hundred and sixty-six species of British Plants, viz. :—		N. J. Winch, Secretary.
	Hippuris vulgaris.	Veronica hybrida.	
	Circæa alpina.	V. filiformis.	

Date.		*Donations.*	*Donors.*
	Veronica agrestis.	S. cæspitosa.	
	Salvia verbenaca.	S. hypnoides·	
	Valeriana rubra.	Dianthus deltoides.	
	V. Calcitrapa.	Silene nutans.	
	Fedia dentata.	S. acaulis.	
	Cladium Mariscus.	Stellaria scapigera.	
	Schœnus nigricans.	Sedum rupestre.	
	Scirpus setaceus.	S. Forsterianum.	
	Eleocharis palustris.	Spergula subulata.	
	Eriophorum alpinum.	Mespilus Cotoneaster.	
	E. pubescens.	Spiræa Filipendula.	
	E. angustifolium.	Rosa spinosissima.	
	Nardus stricta.	R. spinosissima β Ciphiana.	
	Agrostis canina,	R. Doniana.	
	Aira cristata.	R. gracilis.	
	Poa glauca.	R. gracilis, β flore alba.	
	Triticum cristatum.	R. Sabini, α.	
	T. loliaceum.	R. Sabini, β.	
	Rubia peregrina.	R. villosa.	
	Cornus suecica.	R. tomentosa.	
	Myosotis palustris.	R. scabriuscula.	
	M. cæspitosa.	R. sarmentacea, β glau-	
	Menyanthes nymphæoides	cophylla.	
	Lysimachia Nummularia.	R. Forsteri.	
	Convolvulus Soldanella.	Rubus affinis.	
	Lobelia Dortmanna.	R. suberectus.	
	ImpatiensNoli-me-tangere	Potentilla verna.	
	Viola lutea.	P. opaca.	
	Verbascum Lychnitis.	Papaver cambricum.	
	Erythræa littoralis.	Nuphar pumila.	
	Ribes petræum.	Tilia grandiflora.	
	Thesium linophyllum.	T. corallina.	
	Myrrhis aromatica.	Cistus marifolius.	
	Staphylea pennata.	C. Helianthemum.	
	Linum catharticum.	C. tomentosus.	
	Allium Schænoprasum.	Aquilegia vulgaris.	
	Scilla verna.	Trollius europæus.	
	Juncus filiformis.	Caltha radicans.	
	J. uliginosus.	Ajuga Chamæpitys.	
	Luciola congesta.	Mentha arvensis, γ præcox.	
	Frankenia levis.	Glechoma hederacea.	
	Oxyria reniformis.	Lamium amplexicaule.	
	Alisma ranunculoides.	Scrophularia vernalis.	
	Trientalis europæa.	Antirrhinum Cymballaria.	
	Epilobium alsinifolium.	Sibthorpea europæa.	
	E. alpinum.	Hutchinsia petræa.	
	Acer campestre.	Teesdalia nudicaulis.	
	Pyrola minor.	Nasturtium amphibium.	
	Saxifraga stellaris.	Sisymbrium Irio.	
	S. aizoides.	Arabis hispida.	
	S. tridactylites.	A. Turrita.	
	S. moschata.	Brassica campestris.	

Date.	*Donations.*	*Donors.*
	Althæa officinalis.	
	Genista tinctoria.	
	Anthyllis Vulneraria.	
	Lathyrus sylvestris.	
	L. palustris.	
	Ornithopus perpusillus.	
	Hippocrepis comosa.	
	Trifolium suffocatum.	
	Gnaphalium dioicum.	
	G. hyperborium.	
	Senecio saracenicus.	
	Matricaria Chamomilla.	
	Orchis bifolia.	
	O. pyramidalis.	
	O. ustulata.	
	O. fusca.	
	O. viridis.	
	Aceras anthropophora.	
	Ophrys ovata.	
	Epipactis latifolia.	
	E. grandiflora.	
	Euphorbia Cyparissias.	
	E. hybernica.	
	E. amygdaloides.	
	Carex axillaris.	
	C. capillaris.	
	C. limosa.	
	C. atrata.	
	C. pallescens.	
	C. lævigata.	
	Carex filiformes.	
	Littorella lacustris.	
	Myriophyllum spicatum.	
	Betula alba β.	
	Salix lanceolata.	
	S. tenuifolia.	
	S. fragilis.	
	S. Helix.	
	S. rubra.	
	S. Forbiana.	
	S. glauca.	
	S. arenaria.	
	S. rosmarinifolia.	
	S. Andersoniana.	
	S. Forsteriana.	
	S. alba.	
	Myrica Gale.	
	Rhodiola rosea.	
	Equisetum variegatum.	
	Polypodium Dryopteris.	
	Asplenium marinum.	
	Scolopendrium Ceterach.	
	Pteris crispa.	
	Hymenophyllum Wilsoni.	
	Isoetis lacustris.	
	Bartramia arcuata.	
	B. fontana.	
	Neckera crispa.	
	Hypnum abietinum.	
	Thirty-seven species of Exotics.	N. J. Winch, Secretary.
	Salix vitellina.	
	S. monandra.	
	S. retusa.	
	S. depressa.	
	Lambertia formosa.	
	Gelia capitata.	
	Primula farinosa.	
	Azalea procumbens.	
	Erythræa australis.	
	Gomphocarpus arborescens.	
	Gentiana asclepiadea.	
	Cyanella capensis.	
	Œnothera tenella.	
	Œ. viminea.	
	Andromeda speciosa.	
	Eriostemon salicifolium.	
	Dianthus prolifer.	
	D. plumarius.	
	Silene picta.	
	Rosa moschata.	
	Potentilla formosa.	
	P. atro-sanguinea.	
	P. hybrida.	
	Geum coccineum.	
	Eschscholzia californica.	
	Leonurus leptophyllus.	
	Mimulus parviflorus.	
	M. moschatus.	
	M. guttatus.	
	Geranium Wallichianum.	
	Kennedia monophylla.	
	K. rubicunda.	
	Œdera prolifera.	
	Chrysantheum monspeliensis.	
	Buxus balearica.	
	Platanus orientalis.	
	Cyperus sempervirens.	

Date.	*Donations.*	*Donors.*
	Eleven Species of British plants, viz. Veronica officinalis — Pteris crispa Aspidium Lonchitis — Lycopodium Selago A. lobatum — L. selaginoides Cyathæa fragilis — L. alpinum Asplenium viride — Equisetum variegatum A. Adiantum nigrum	W. C. Trevelyan, Esq. Wallington.

MINERALS.

1830. February	Twenty-two specimens of White Lead Ore, from Lead Hills, Scotland.	Henry Witham, Esq.
	Eighteen Geological specimens from Teasdale, with a paper.	W. C. Trevelyan, Esq. Wallington.
	Eight specimens of minerals, viz. Rock Crystral, (Bass's Straits.) Ditto, (Port Jackson.) Wood Opal, (Van Dieman's Land). Opal, (Madeira.) Woodstone, (New South Wales.) Emery, (Naxos.) Clay Iron Stone, with Cellular, Quartz (River Hunter, New South Wales.) Galena, (Cape de Gates,) And various Geological specimens.	Mr. John Taylor, Boldon.
	Thirty-seven species of Fossil Shells, 1 Astacus, 1 Cidarus, and 1 Spongia, viz. Ammonites — Nucula Astacus — Do. Astarte carinata — ——— nuda ——— lurida — Pecten ——— do. & a Pecten — Pinna mitis Belemnites gracilis — Rostellaria trifida Cucullæa concinera From the Oxford Clay, Scarbro'. Amphidesma recurvum — Ostræa Gryphæa dilatata — Perna quadrata Lucina lirata From Kelloway's Rock, Scarbro'. Grevillæa plana — Turbo lævigatus Lingula Beanii — Turritella cingenda Patella argentea — Vermicularia compressa From the Inferior Oolite, (Peak.) Terebratula trilineata (Inferior Oolite, Glaizedale.) — Trigonia clavellata, (Coralline Oolite, Pickering.) Pecten — Tellina amplicata From the Coralline Oolite, Malton. Spongia flaviceps, (Coralline Oolite, Hackness.)	Mr. Bean, Scarbro'.

Date.	*Donations.*	*Donors.*
	Nucula Ovum Unio Trigonia literata From the Lias, Lower Shale, Robin Hood's Bay.	
	Corbula depressa Cidaris vagaris From the Grey Limestone, Scarbro'.	
	Mya literata Terebratula ovoides Terebratula digona From the Cornbrash, Scarbro'.	
	Terebratula subrotundata, (Spreton Clay.)	
	Cardium truncatum, (Marlstone, Robin Hood's Bay.)	
	Pecten Scarburgensis, (Calcareous Grit Scarbro'.)	
	Amethystine Quartz Calcareous Spar on Quartz	Mrs. Forrester.
	226 specimens of various minerals from Vesuvius.	Sir M. W. Ridley, Bart., M. P.
	Two specimens of Celestine, from Agrigentum.	C. W. Bigge, Esq.
	Iron Flint, (Saxony.) Pitchstone, (Egg.) Chrysoprase (Do.) Pitchstone Porphyry, (Egg.) Menilite, (Paris.) Fetstein, (Norway.) Porcelain Jasper. Omphacite, (Baffin's Bay.) Yenite, (Elba.) Acmite, (Norway.) Cyprine, (Norway.) Iron Sand and Garnets, (La Guayra Beach.) Prehnite, (Kilpatrick.) Sphene, (Norway.) Brewsterite, (Strontian.) Subsulphate of Alumina. Heulandite, (Kilpatrick.) Sulphate of Barytes (Hartz.) Harmatome, (Strontian.) Do. Do. (Transylvania.) Carbonate of Strontian, (Strontian.) Calc. deposit formed in an Engine Cylinder, old Walker colliery. Anhydrous Gypsum, (Tyrol.) Sahlite, (Norway.) Serpentine, (Do.)	Mr. W. Hutton, Secretary.
	Opal, (St. Nicholas Guanaxuato.) Serpentine, (Ditto.) 13 specimens of Iron Pyrites, (Mine of Sirena Veta Madre Guanaxuato.) 39 Silver Ores, (Guanaxuato.) Native Gold, with the Sand in which it is found, (from the river Cheran, Savoy.) Mountain Cork, (Guanaxuato.) Native Iron, Catorie, (Mexico.) Brown Hæmatites, (streams near Guanaxuato.) 3 specimens of Cinnabar (Rinion de Centeno.) Native Gold, (Peregrina.) Ditto, (Siberia.) Calc. Spar on Quartz, (Guanaxuata.)	John Williamson, Esq.
	Garnet, (Norway.) Schiller Spar. Idocrase, (Ditto.) Wavellite, (Devonshire.) Obsidian, (Iceland.)	John Adamson, Esq.
April.	Nine cut and polished specimens of Fossil Wood, and a number of specimens of recent Woods.	H. Witham, Esq.

Date.	*Donations.*	*Donors.*
May.	Blende, (Alston.) Fluor Spar, (Alston.) Baryto-Calcite, (Alston.) Atacamite, (Desert of 3 spec. of Calc. Spar, (do.) Atacama, Peru.) Jet, (Whitby.)	J. Fryer, Esq.
May.	Natrolite Antrim Rutilite, (Killin.)	N. J. Winch, Sec.
May.	44 Rock specimens, illustrative of a paper on the New Red Sandstone of the County of Durham, below the Magnesian Limestone.	W. Hutton, Sec.
	Specimens to illustrate a notice of a group of Dykes in Whitehaven Colliery.	Mr. Williamson Peel.
	Specimen of Mineralized Wood, from the Cliffs near Newbiggin Church, Northumberland.	N. J. Winch, Sec.
July.	60 Rock specimens illustrative of the Geology of the Banks of the Tweed from Carham, in Northumberland, to Berwick.	N. J. Winch, Sec.
	Twelve Geological Specimens.	Mr. F. Forster, Newcastle.
	Ten Geological Specimens, from New South Wales, &c.	Mr. Taylor, Boldon.

MISCELLANEA.

Specimen of Silk as found wild in the forests of the Sierra Gorda; State of Queretaro, South America; and a Purse made of Abestus.	John Williamson, Esq.
Preserved Head of a New Zealand Chief, and an Ornament made of Feathers for the Head of Ditto, and two specimens of Spunge from Port Jackson.	Mr. Taylor, Boldon.
Skeleton of the Red-necked Grebe *(Podiceps rubricollis)*.	Mr. Thornhill, Curator of the Newcastle Museum.
Ditto of a Greenfinch.	

BOOKS, &c.

Herbarium deluvianum collectum, a J. J. Scheuchzero, M. D.	W. C. Trevelyan, Esq. Wallington.
Geological Sections of Holyfield, Hudgill Crossvein, and Silverband Lead Mines, in Alston Moor and Teesdale.	Mr. T. Sopwith, Newcastle, the Author.
A Section of the Strata passed through in the Main Main Drift, in Gosforth Colliery.	Mr. T. Embleton.

PURCHASES.

BIRDS.

Wood Sandpiper *(Totanus grallatoris)*. shot at Prestwick Car, May, 1830.
Velvet Duck *(Anas fusca)*.
Little Egret *(Ardea Garzetta)*.
Sanderling in winter plumage *(Calidris arenaria)*.
Woodchat *(Lanius rufus)*.
Spotted Sandpiper *(Totanus macularius)*, male and female.
Twite *(Fringilla Montium)*.
Knot *(Tringa cinerea)*, summer plumage.
Cirl Bunting *(Emberiza Cirlus)*.
Little Egret *(Ardea Garzetta)*.
Gardenian Heron *(Ardea Nycticorax, jun.)*.
Glossy Ibis *(Tantalus Falcinellus)*.
Alexandrine Plover *(Charadrius Hiaticula, jun.)*
Temminck's Sandpiper *(Tringa Temminckii)*.
Alpine Warbler *(Accentor alpinus)*.
Common Godwit, in summer plumage *(Limosa rufa.)*
Common Snipe *(Scolopax Gallinago)*.
Common Sandpiper *(Totanus hypoleucos)*.
Guernsey Partridge *(Perdix rufa)*.
Black Tern *(Sterna fissipes)*.
Wood or Long-legged Sandpiper *(Totanus grallatoris)*.

INSECTS.

200 species of South American Insects.

MINERALS.

Topaz (Siberia).
Laumonite (Huelgot).
Adularia (St. Gothard).
Cinnamonstone (North America).
Pyrophysalite (Finbo).
Pinite (Auvergne).
Staurolite (Bretagne).
Malachite (Hartz).
Natrolite (Wirtemberg).
Lepidolite (Moravia).
Pycnite (Saxony),
Chondrodite (Finland).
Realgar (Hungary).
Boracite (Saxony).
Manganesian Epidote (Piedmont).
Allophane (Hungary).
Albite (Dauphiny).

LIST OF PRESENTS AND PURCHASES,

IN THE YEARS 1830–1831.

QUADRUPEDS.

Date.	*Donations.*	*Donors.*
1831. January.	A specimen of the Fox *(Canis Vulpes*, Lin.*)*.	Ben. Johnson, Esq. Newcastle.
February.	A specimen of the Stoat *(Mustela Erminea*, Lin.*)*	Ben. Johnson, Esq. Newcastle.
April.	Two specimens of the Water Shrew *(Sorex fodiens)*.	Mr. J. Armstrong, Bardon Mill.
May.	A specimen of the common Bat *(Vespertilio murinus*, Lin.*)*.	Mr. Robson, Newcastle.

BIRDS, &c.

1830. August.	Two Pairs of the Pied Flycatcher.	Mr. T. Ridley.
	Wild Swan *(Cygnus ferus)*.	Wm. Mills, Esq., Willington.
	Two young Male Sparrowhawks *(Falco Nisus*, Lin.*)*.	Mr. Hepper, Close-house.
	Young Willow Wren *(Sylvia trochilus)*.	Mr. D. Embleton, Newcastle.
	Skins of thirty Birds from North America.	J. J. Audubon, Esq.
	Two young Woodcocks.	Mr. Hedley, Healeyfield.
September.	Young Arctic Tern *(Sterna arctica*, Temm.*)*; mature Bird of ditto, and young Lesser Black-backed Gull *(Larus fuscus*, Lin.*)*.	Mr. W. C. Hewitson.
	Greater Spotted Woodpecker *(Picus major*, Lin.*)*.	Mr. Thos. Burnet, Newcastle.

Date.	*Donations.*	*Donors.*
	Solitary Snipe *(Scolopax major).*	Colonel Shadforth, Witton-le-Wear.
	Hanging Nest.	John Buddle, Esq.
	Skins of thirteen Birds from the Mauritius, Cape of Good Hope, and Bengal.	Mr. Robert Currie.
	Two specimens of the Knot, *immature (Tringa Canutus,* Lin.*)*; one of the Sanderling *(Calidris arenaria,* Temm*)*; two of the Arctic Gull, *immature (Larus parasiticus,* Lin.*)*; and one of the common Godwit *(Limosa rufa,* Temm.*).*	Mr. E. Backhouse, jun., Sunderland.
	One specimen of the Reeve *(Tringa Pugnax,* Lin.*)*; and one of the Dunlin *(Tringa variabilis,* Temm.*).*	Rev. R. Green, Newcastle.
	Wheatear *(Saxicola Œnanthe,* Temm.*).*	Mr. Wilkinson.
	Grey Phalarope *(Phalaropus lobatus,* Lin.*).*	Mr. Geo. Lawson, Heddon-on-the-Wall.
October.	Green Sandpiper *(Tringa ochropus,* Lin.*).*	T. V. R. Dutton, Esq.
	The Eggs of one hundred and twenty-seven species of British Birds.	Geo. C. Atkinson, Esq.
	Red-legged Crow *(Pyrrhocorax graculus,* Temm.*).*	Dr. Geo. Johnston, Berwick-upon-Tweed.
	Creeper *(Certhia familiaris,* Lin.*).*	Mr. John Thompson, Crowhall Mill, near Hexham.
	Hooded Crow *(Corvus Cornix,* Lin.*).*	Rev. R. Green.
December.	Bohemian Chatterer *(Bombycivora garrula,* Temm *).*	Mrs.Losh,Jesmond.
	Skins of three Birds from Greenland.	Rev. Geo. C. Abbs, Gateshead.
	Water Rail *(Rallus aquaticus,* Lin.*).*	Mr. I. T. Cookson.
	Waterhen *(Gallinula chloropus,* Lin.*).*	Master J. Dutton.
	Moor Buzzard, female *(Falco æruginosus,* Lin.*).*	Mr. R. Dickinson, Alston.
	Female Bulfinch.	Mr. R. Shield, Newcastle.
	Peregrine Falcon, female *(Falco peregrinus,* Lin.*).*	Rev. W. Rawes, Easington.
	White variety of the Bulfinch.	Mr. M. Wheatley, jun.
	Skins of seven Australian Birds.	Geo. Hodgson, Esq. Newcastle.
	Pair of Starlings *(Sturnus vulgaris,* Lin.*).*	Ben. Johnson, Esq. Newcastle.

Date.	*Donations.*	*Donors.*
1831.	Ptarmigan in summer plumage *(Tetrao lagopus,* Lin.*)*.	Hon.Robt.Liddell.
February.	Oyster-catcher *(Hæmatopus Ostralegus,* Lin.*)*.; Ring Dottrell *(Charadrius Hiaticula,* Lin.*)*; Purple Sandpiper *(Tringa maritima,* Lin,*)*; Dunlin or Purre *(Tringa variabilis,* Temm.*)*.	Mr. J. T. Bell, Newcastle.
March.	Peewit *(Vanellus cristatus,* Temm.*)*.	Rev. R. Green.
May.	Corncrake *(Gallinula crex,* Lin.*)*.	Mr. J. Thompson, Crowhall Mill, near Hexham.
	Two specimens of the Egg of the Common Sandpiper *(Tringa Hypoleucos,* Lin.*)*.	Mr. Richard Atkinson
	Fieldfare *(Turdus pilaris,* Lin.*)*.	Rev. J. Cook, Newton Hall.
	Three Eggs of the Peahen.	Mr. Geo. Wailes, Newcastle.
	Two speeimens of the Rock Dove *(Columba livia,* Temm.*)*.	G. C. Atkinson, Esq.
June.	Nest, eontaining 15 Eggs, of the Blue Titmouse *(Parus cæruleus)*.	Rev. T. Gisborne, Durham.
	Three Hanging Nests from Bengal.	Mr. Hepper, Closehouse.
	Twenty-two speeies (Thirty-one specimens) of Birds from South America.	Mrs. Collinson, Gateshead.
	Three specimens of the Kestril.	Mr. Hepper, Closehouse.
July.	Eight speeies of Birds from Spain, viz.—Pteroeles arenarius. Purple Starling *(Sturnus unicolor,* Temm.), two specimens; Black Redtail *(Sylvia Tithys,* Temm.*)*; Sylvia eonspicillata, Lanius meridionalis, Blue Magpie *(Corvus cyaneus,* Pallas*)*; White-tailed Stonechat *(Saxicola cachinnans)*; and Rousset Wheatear *(Saxicola Stapazina)*.	Capt. Cook, Newton Hall.
	The Eggs of fourteen speeies of British Birds from St. Kilda, viz.—Gannet *(Sula alba)*; Puffin *(Mormon Fratercula)*; Shearwater Petrel *(Procellaria Anglorum)*; Fulmar Petrel *(Procellaria glacialis)*; Stormy Petrel *(Procellaria pelagica)*; Black-headed Gull *(Larus atricilla)*; Black-headed Gull *(Larus marinus)*; Herring Gull *(Larus argentatus)*; Razorbill *(Alca Torda)*; Foolish Guillemot *(Uria Troile)*; Black Guillemot *(Uria Grylle)*; Rock Pigeon *(Columba livia)*; Shag *(Carbo graculus)*; Common Sandpiper *(Tringa hypoleucos)*.	G. C. Atkinson, Esq.

FISHES.

Date.	*Donations.*	*Donors.*
1830. October.	Common Weever *(Callyonymus Dracunculus*, Lin.*)*.	Mr. W. A. Mitchell, Newcastle.
1831. January.	A specimen of the Fish, called the Vendace, from Lochmaben, Dumfries-shire.	Mr. Dunbar, Newcastle.
	Trunk Fish *(Otion cornutum*, Lin.*)*.	Dr. Kell.
	Pipe Fish.	H. Hewitson, Esq. Seaton Burn.

AMPHIBIOUS ANIMALS.

	A Chamæleon *(Lacerta Chæmeleon*, Lin.*)*.	Mr. J. Watson, Alnwick
1830. December.	Seven Snakes, from the West Indies.	Mr. A. Campbell, Newcastle.

CRABS, &c.

1830. October.	Cleanser Crab *(Cancer Depurator*, Lin.*)*.	Mr. W. A. Mitchell, Newcastle.
	Eight species of Cancer, from the Mauritius.	Mr. Robt. Currie.
	Sea Urchin *(Echinus Stratagus*, Lin.*)*.	Rev. G. C. Abbs, Gateshead.

INSECTS.

1830.	Larva of the Stagbeetle.	Mr. Jas. Thoburn, Blyth.
October.	Twenty-five specimens of British Insects.	Mr. Jas. Cameron, Newcastle.
December.	Two hundred and sixty specimens of Foreign Insects.	Geo. Children, Esq. of the British Museum.
	Twelve specimens of the Tarantula Spider *(Aranea Tarantula*, Lin.*)*.	D. Dixon, Esq., Newcastle.
1831. January.	Forty-four species of Insects, from the Mauritius and Bengal.	Mr. Robt. Currie.
May.	One hundred and thirteen species (one hundred and ninety-one specimens) of British Insects.	Mr. W. C. Hewitson.
	Two species of British Insects.	Mr. J. A. Turner, Manchester.
June.	Twenty species (twenty-seven specimens) of South American Insects.	Mrs. Collinson, Gateshead.

SHELLS.

September.	Three species of Shells.	The Misses Witham, Edinburgh.

Date.	*Donations.*	*Donors.*
	Seven species of shells.	John Adamson, Esq.
October.	Six ditto ditto.	J. H. Fryer, Esq.
	Three ditto ditto.	Miss Davidson, Westgate Street.
October.	Five species of shells.	Miss Julia Forster, Alnwick.
1831.	Two ditto ditto from Gareloch, near Helensburgh.	The Misses Witham.
February.	Five ditto ditto.	J. H. Fryer, Esq.
	Three ditto ditto.	Rev. Mr. Mark, Tynemouth.
	Two ditto ditto.	Mr. J. Alder, Newcastle.
March.	Two ditto ditto.	Miss Julia Forster, Alnwick.
	Forty ditto ditto.	Mr. Joshua Alder, Newcastle.
June.	Two ditto ditto	Mrs. Collinson, Gateshead.

WORMS.

1830. September.	Specimen of the Amphitrite Ventrilabrum, with a Box made of the Wood of one of the ships wrecked in Vigo Bay. The wood has been much perforated by the Teredo navalis, in one of whose holes the above specimen was found.	Dixon Dixon, Esq.

ZOOPHYTES.

1831. January.	Five specimens of Brainstone Coral.	Thos. Doubleday, Esq., Newcastle.
	Five specimens of Coral.	Mrs. Collinson, Gateshead.
	Specimen of Coral.	Miss Davidson, Westgate-street.

PLANTS.

1830. September.	A Lusus Naturæ of the Malva sylvestris, from near Ryhope.	Miss Collingwood, Bishopwearmouth.
October.	Nineteen species of Conferva and Fuci, from near Belfast.	Dr. Drummond, Belfast.
	Musci Thuringici. Vivis exemplaribus exhibuerunt et illustraverunt Jonathan Carolus Zenker et Fredericus David Dietrich.	W. C. Trevelyan, Esq.
1831. January.	Twenty-seven species of Plants, from Calcutta and the Mauritius.	Mr. George Currie.

Date.	*Donations.*	*Donors.*
June.	Seeds of six South American Plants.	J. H. Fryer, Esq.
	MINERALS.	
1830.	A collection of specimens of Bovey Coal.	W. C. Walters, Esq., Newcastle.
August.	One hundred and nine specimens of Minerals.	Rev. W. Hawks.
	One specimen of Jet.	Mr. N. J. Winch.
September.	Vitreous Sand Tube, from Drig, Cumberland.	Geo. C. Atkinson, Esq.
October.	Five Specimens of Minerals, from Italy.	Miss Davidson, Westgate-street.
	Specimen of Anthracite, from North America.	D. Dixon, Esq.
	Eighteen specimens of Minerals.	C. W. Bigge, Esq., Linden.
	Four specimens of Wavellite, on Iron Stone, from Low Moor, and two of Titanium, from a Blast-furnace, at that place.	C. H. Dawson, Esq. Royd's Hall.
December.	Eight specimens of Minerals.	Mr. E. H. Pollard, Newcastle.
	Three specimens of Minerals, from Felling Colliery.	Mr. John Grace, jun., Felling Hall.
	Three specimens of Minerals, from the Giant's Cause-	Mr. John Mountain,
1831.	way.	Newcastle.
June.	Specimen of Obsidian, from Ascension Island, and two Volcanic specimens, from Deception Island, South America.	Mrs. Collinson, Gateshead.
	GEOLOGICAL SPECIMENS.	
1830. July.	Specimen of a Fossil Tree discovered in Wideopen Quarry, Northumberland.	Rev. R. H. Brandling.
	Nine specimens of Vegetable Impressions, from Percy Main Colliery.	Mr. Robert Atkinson, Percy Main.
	Casts of the Track of Footmarks of Animals, found impressed in the Sandstone of the Quarry at Corncockle Muir, in Dumfries-shire.	H. Witham, Esq.
	Fossil Fish, from the Magnesian Limestone, at Houghton-le-Spring.	Mr. Robinson, Houghton.
	A Fossil, from the Limestone, at Rothbury.	Mr. J. Storey, Rothbury.
August.	Six specimens of Fossils, found at Port des Barques, at the mouth of the river Charente, France.	Capt. Collingwood.
	Eleven specimens of Iron Ore, Limestone, and Coal, from Staffordshire.	Mr. J. Green, Architect, Newcastle.

Date.	*Donations.*	*Donors.*
August.	Two Masses of Sandstone, containing Productus from Allendale.	Mr. J. Watson, Solicitor, Newcastle.
	Four specimens of a Fossil Tree.	H. Witham, esq.
September.	Fossil Fish, from Down Hill.	Rev. G. C. Abbs.
	Specimen of Sandstone, containing Productus.	Mr. R. Armstrong, Newcastle.
	Ten Fossil Shells, from the Folkstone Blue Gault.	Mr. John Phillips, Keeper of the York Museum.
	Four Geological Specimens, from Whitby.	Mr. N. J. Winch.
	A specimen of the Bognor Rocks on the coast of Sussex.	Dr. Collingwood, Sunderland.
	Four Geological Specimens.	C. W. Bigge, Esq.
November.	One hundred and fifty specimens of Vegetable Fossils, from Low Moor.	C. H. Dawson, Esq.
	Specimen of a Fossil Tree, lately discovered in Killingworth Colliery.	Mr. Nicholas Wood, Killingworth.
December.	Fossil Fern. *(Pecopteris crenifolia)*, in fructification.	Dr. Murray, Scarbro'.
	Twenty-four Chalk Fossils, Madrepore in White Lias (Bristol), Fossil Shells, from the Inferior Oolite, and in Marlstone (Peak).	Mr. W. Hutton.
	Specimens of the Strata in Monkwearmouth Colliery, at the termination of the Limestone; depth, 53 fathoms.	T. Pemberton, Esq. Bishopwearmouth.
January.	Large specimen of Shale, with Vegetable Impressions, from Felling Colliery.	Mr. John Grace, jun.
February.	Fossil Horn of the Red Deer, found near Milburn.	Mr. Bates, Milburn.
	Specimen of one of the Basaltic Pillars of the Giant's Causeway.	Mr. John Mountain.
May.	Polished specimen of Limestone, containing Madrepores, from Kellhead, Dumfries-shire.	Mr. E. Birnie, Dumfries.
	Specimens of Nuts, from a submarine Forest, near Whitburn.	Mr. Robert Atkinson, Percy Main.
	Fossil Wood.	Mr. R. Davidson.
	Specimen of the Craigleith Fossil Tree.	H. Witham, Esq.
	Three specimens of Shale, with Vegetable Impressions.	Mr. Hutton.

BOOKS.

1830. October.	Natural History of the Vicinity of Stockton-upon-Tees, by John Hogg, M. A.	The Author.
November.	Mr. Witham on Vegetable Fossils.	The Author.
1831. January.	Vol. I. Part I. of Zoological Researches, and Illustrations, or Natural History of Nondescript or imper-	The Author.

Date.	*Donations.*	*Donors.*
	fectly known Animals, in a series of Memoirs, with figures, by John V. Thompson, F. L. S.	The Author.
January.	Index to the Historia Conchyliorum of Lister, by L. W. Dillwyn, F. R. S. & F. L. S.; and by the same Author, a List of Insects, found near Swansea.	The Author.
	No. I. New Series, of the Edinburgh Journal of Natural and Geographical Science, conducted by H. H. Cheek.	The Editor.
	Nos. I. & II. of British Oology, by W. C. Hewitson.	The Author.
June.	The Annual Report of the Yorkshire Philosophical Society for 1830, with a List of Members and Contributors, 1831.	The Society.
	Synopsis Reptilium, or short Descriptions of the Species of Reptiles, by John Edward Grey, F. Z. S., F. G. S., &c. &c.	The Author.

MISCELLANEOUS.

1831. August.	A Lasso, from South America.	R. Wilkie, Esq., Ladythorne.
	A Calabash and Basket, from South America. The Basket made by the inhabitants of Terra del Fuega.	Mrs. Collinson, Gateshead.

PURCHASES.

Purple Heron *(Ardea purpurea)*, with one of its Eggs. The male and female Birds, with the Nest and Eggs, were procured in Lincolnshire.

The Egg of the Spoonbill *(Platalea Leucorodia)* also procured in Lincolnshire.

The Golden-eye Duck *(Anas Clangula)*.

Two hundred and eighty species of Shells.

Forty-five specimens of Alston Minerals.

Two specimens of Copper Pyrites, from Cornwall.

Fine specimen of Coral.

Four specimens of polished Fossil Woods.

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END OF VOL. I.

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EXPLANATION OF THE PLATES.

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